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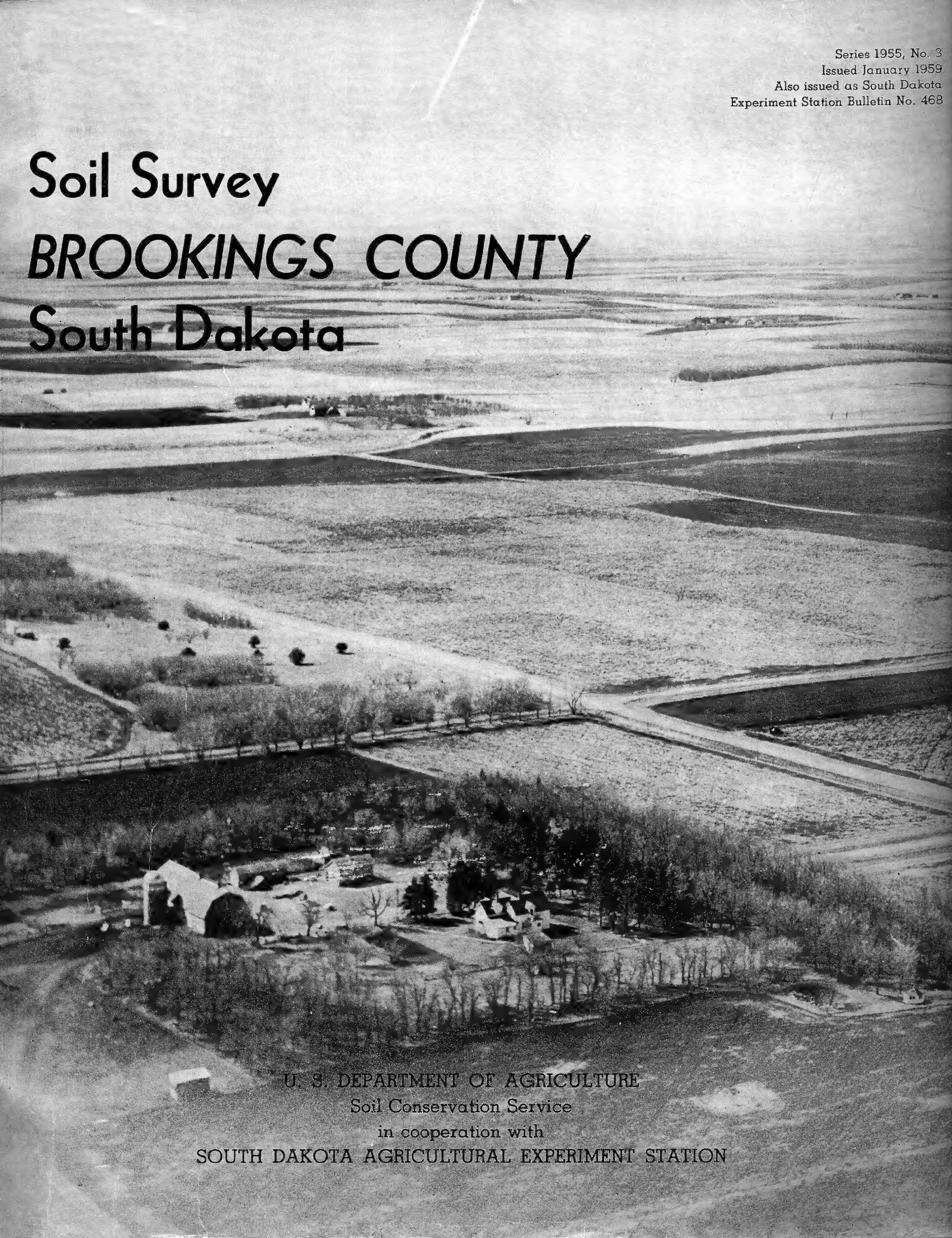
Soil Survey
BROOKINGS COUNTY
South Dakota



U. S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service
in cooperation with
SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

How to Use THE SOIL SURVEY REPORT

THIS SURVEY of Brookings County will help you plan the kind of farming that will protect your soils and provide good yields. It describes the soils; shows their location on a map; and tells what they will do under different kinds of management.

Find Your Farm on the Map

In using this survey, start with the soil map, which consists of the sheets bound in the back of this report. These sheets, if laid together, make a large photographic map of the county as it looks from an airplane. You can see fields, roads, rivers, and many other landmarks on this map.

To find your farm on the large map, use the index to map sheets. This is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located.

When you have found the map sheet for your farm, you will notice that boundaries of the soils have been outlined in red, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map.

Suppose you have found on your farm an area marked with the symbol Kc. You learn the name of the soil this symbol represents by looking at the map legend. The symbol Kc identifies Kranzburg silt loam, nearly level.

Learn About the Soils on Your Farm

Kranzburg silt loam, nearly level, and all other soils mapped are described in the section, Description of Soil Series and Soil Mapping Units. Soil scientists walked over the fields and grasslands. They dug holes and examined surface soils and subsoils; measured slopes with a hand level; noted differences in growth of crops and grass; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming.

After they studied and mapped the soil, the scientists placed the soil in a management group and subgroup on the basis of its characteristics and qualities. The soils in a management group need and respond to about the same kind of management. In this report the management groups have been subdivided into subgroups so that management can be more precisely defined.

Kranzburg silt loam, nearly level, is in management subgroup 2A. In each soil unit description, the arabic number and capital letter that follows the soil symbol designates the management subgroup. Turn to the section, Use, Management, and Productivity of Soils and read what is said about management in general and then read about the soils in management subgroup 2A. How much you can expect to harvest from Kranzburg silt loam, nearly level, under five systems of management and three growing conditions is shown in table 6.

Make a Farm Plan

For the soil on your farm, compare your yields and farm practices with those given in this report. Look at your fields for signs of runoff and erosion. Then decide whether or not you need to change your methods. The choice, of course, must be yours. This survey will aid you in planning new methods, but it is not a plan of management for your farm or any other farm in the county.

If you find that you need help in farm planning, consult the local representative of the Soil Conservation Service or the county agricultural agent. Members of your State experiment staff and others familiar with farming in your county will also be glad to help you.

The fieldwork for this survey was completed in 1955. Unless otherwise specifically noted, all statements refer to conditions at the time of the survey.

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Contents

Westin, F C

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SOIL SURVEY OF BROOKINGS COUNTY, SOUTH DAKOTA

By F. C. WESTIN, G. J. BUNTLEY, F. E. SHUBECK, L. F. PUHR, and N. E. BERGSTRESER, South Dakota State College

Surveyed by F. C. WESTIN, in Charge, G. J. BUNTLEY, F. E. SHUBECK, W. M. MOLDENHAUER, J. M. BEARDSLEY, A. J. KLINGELHOETS, G. B. LEE, J. U. ANDERSON, J. K. KRUEGER, and D. I. KETTERING, South Dakota State College

Correlation by C. A. MOGEN, U. S. Department of Agriculture; F. C. WESTIN, and G. J. BUNTLEY, South Dakota State College

United States Department of Agriculture in Cooperation with South Dakota Agricultural Experiment Station

General Nature of the Area[1]

GEOLOGY and physical geography, climate, and vegetation influence soil formation and the use of soils for agriculture. These important features and the location and extent of the county are discussed briefly in this section.

Location and Extent

Brookings County lies along the eastern boundary of South Dakota. The air mileage from Brookings, the county seat, to Pierre, the State capital, and to other cities and towns in South Dakota is shown in figure 1. The distance from the eastern boundary of the county to the western is about 34 miles; that from the northern boundary to the southern is about 20 miles. The area of the county is 512,640 acres, or 801 square miles.

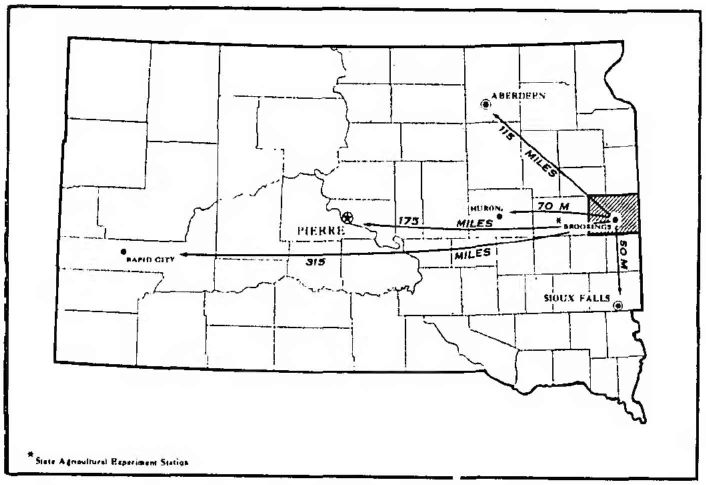

Figure 1.—Location of Brookings County in South Dakota.

Geology and Physical Geography

Almost the entire eastern half of South Dakota has been glaciated. This glaciated section is separated from western South Dakota by the Missouri River. The Missouri was formed by the diversion of the major rivers of western South Dakota by glacier ice thought to be of Illinoian age. Underlying the glacial drift are marine Cretaceous strata, which are capped locally by remnants of continental rocks of Tertiary age. Two plateaulike highlands—the Prairie Coteau and the Missouri Coteau—dominate eastern South Dakota. These highlands are separated by the James River lowland (fig. 2). Brookings County lies entirely on the Prairie Coteau at elevations of about 1,600 to 1,800 feet.

The Pleistocene deposits of the county as correlated

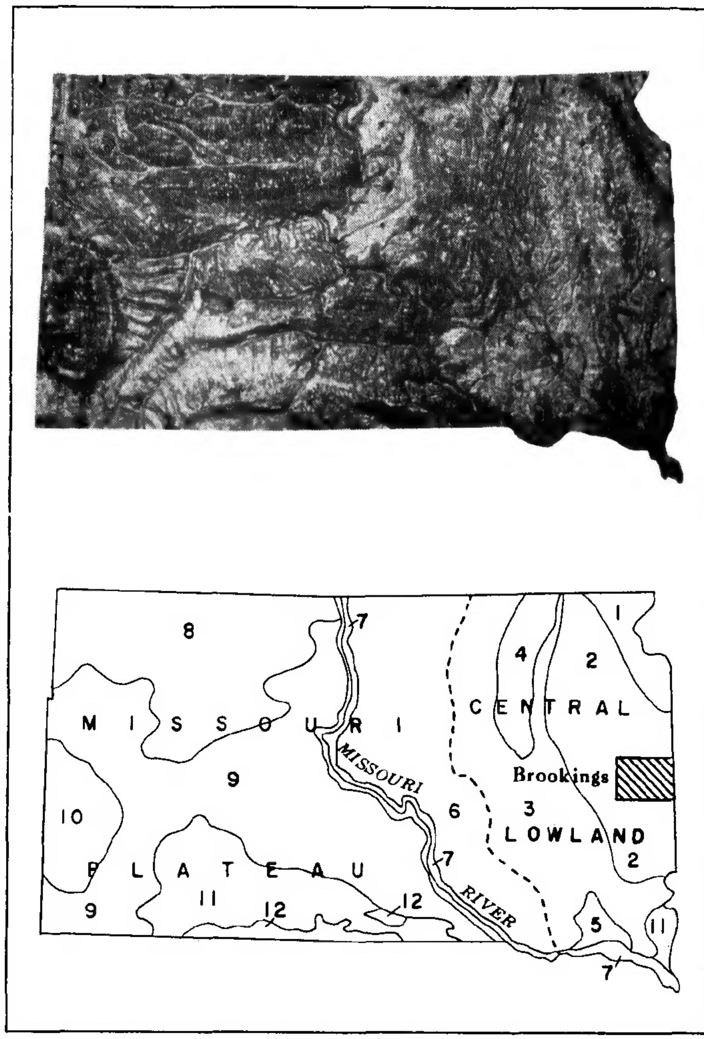

Figure 2.—Physiography of South Dakota. The numbers of the lower sketch show the location of the following physical divisions: (1) Minnesota River-Red River lowland; (2) Prairie Coteau; (3) James River lowland; (4) Lake Dakota plain; (5) James River highlands; (6) Missouri Coteau; (7) Missouri River trench; (8) northern plateaus; (9) Pierre hills; (10) Black Hills; (11) southern plateaus; (12) Sand Hills.

[1] Section written by F. C. WESTIN, agronomist, South Dakota State College Agricultural Experiment Station.

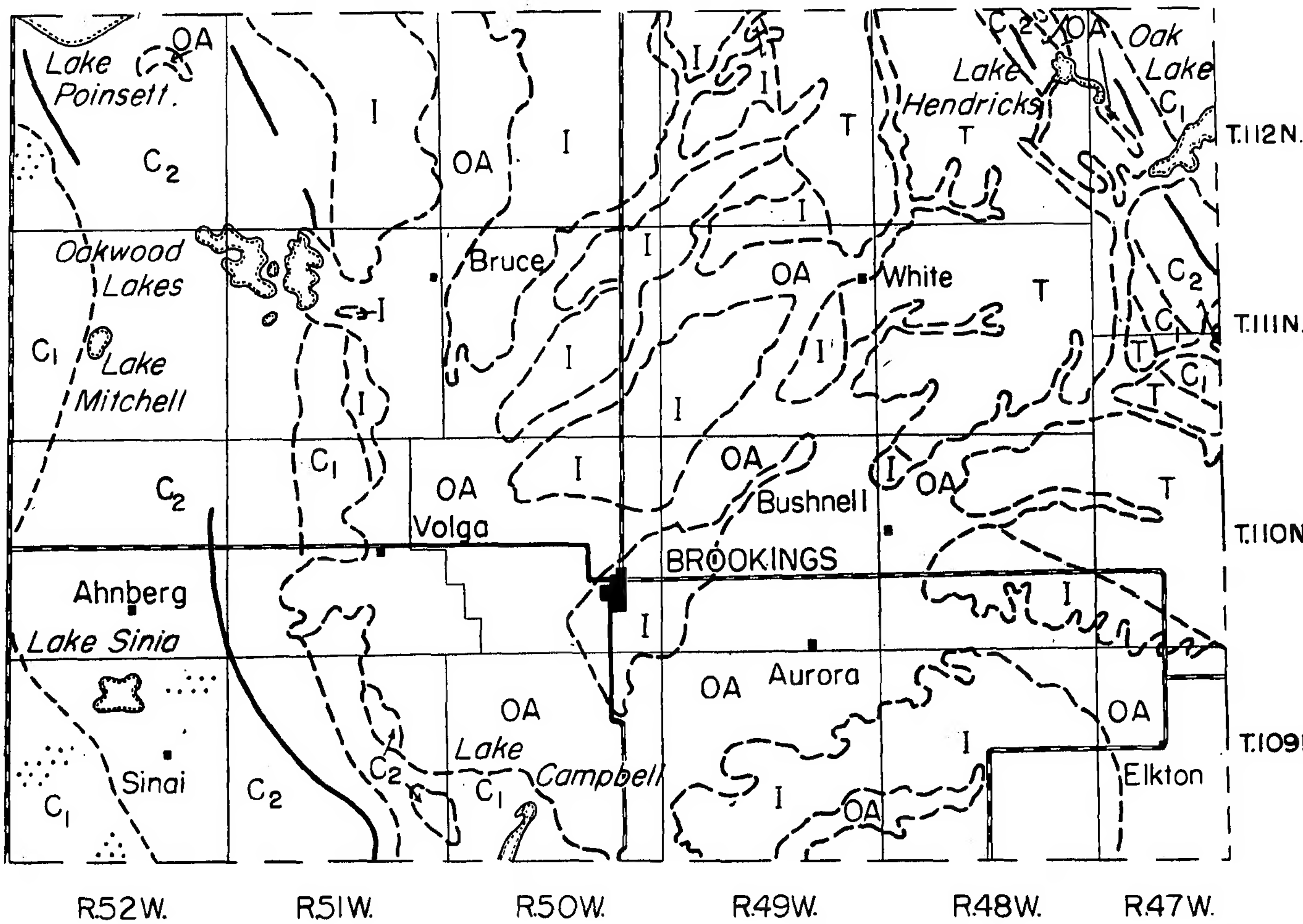

Figure 3.—**Pleistocene deposits of Brookings County, S. Dak. The clusters of dots in the southwestern and northwestern corners represent collapsed drift; the solid lines represent the crests of the end moraines. Other Pleistocene deposits are shown by symbols as follows—I, glacial drift: Iowan substage; T, glacial drift: Tazewell substage; C_1, glacial drift: Cary substage, ground moraine; C_2, glacial drift: Cary substage, end moraine; and OA, alluvium.**

by Flint (*2*)[2] are shown in figure 3. All three till deposits are of Wisconsin Age. From oldest to youngest they are Iowan, Tazewell, and Cary. It is believed that the time interval between the Iowan and Tazewell substages was relatively short but that a significant interval occurred between the Tazewell and Cary substages.

In Brookings County the Iowan drift sheet occurs as a broad belt that trends north and south and parallels the Big Sioux River. Most of it occurs east of the Big Sioux River, but a belt about 3 miles wide is just west of the river in the northern half of the county (fig. 3). The Iowan drift sheet has no end moraines. It is thought to be a thin deposit over a previously dissected surface. It occurs on broad flat ridgetops that break down to smooth, gently sloping sides, which end at drainageways. There are no closed depressions; all streams form an integrated system that drains into the Big Sioux River and its tributaries.

Part of the Iowan till is mantled with loess, and part is free of loess. The general distribution of loess in the county is shown in the general soil area map in the back of this report. The loess, about 2 to 4 feet thick, is thought to have been derived mainly from outwash in the Big Sioux River Valley. At the contact between loess and till in many places a pebble concentrate, or lag, occurs. The pebbles of this lag show evidence of wind cutting.

The Iowan till of Brooking County is loam in texture. It consists of about 40 percent sand, 34 percent silt, and 26 percent clay. The Vienna and its catenal associates are the principal soil series mapped on the Iowan till plain. The loess on the Iowan till is silt loam or silty clay loam in texture. A typical sample consists of 18 percent sand, 58 percent silt, and 24 percent clay. The Kranzburg and its catenal associates are the principal soil series mapped in this loess.

The Tazewell drift sheet occurs in a belt 5 to 7 miles wide that is parallel to and northeast of the Iowan drift (fig. 3). It is similar to the Iowan drift in that it is thin and differentially covered by loess. According to Flint (*2*), the Tazewell drift has a discontinu-

[2] Italic numbers in parentheses refer to Literature Cited, p. 86.

ous end moraine in Hamlin and Deuel Counties to the north, but in Brookings County it is marked by a broad swell, the outer slope of which is much steeper than the general slope of the Iowan drift surface beyond it.

The Tazewell and Iowan drift sheets appear similar in topography except that on the Tazewell the surface relief generally is stronger and a few small undrained basins occur. The same soil associations that occur on the Iowan drift sheet are mapped on the Tazewell.

The Cary drift sheet occupies the western third of the county and the northeastern corner (fig. 3). Apparently a long time interval separated the Tazewell and Cary substages, because the surface of the Cary drift sheet differs conspicuously from the surfaces of the Iowan and Tazewell. The Cary surface has many closed depressions and much stronger local relief than the Iowan or Tazewell. Surface drainage is poorly developed. Although some of the differences in the surfaces of the Tazewell and Cary drifts can be attributed to differences in age, the principal causes of the great contrast in their surfaces have not been clearly set forth (*2*).

The Cary till in Brookings County is not uniform in texture, and its land forms are irregular. Three types of land forms that have soil materials of characteristic texture occur. First are those with rolling to hilly end moraine relief, where soil materials are mixed loam till and some gravelly outwash. Second is the general Cary surface that has rounded slopes and nearly level to strongly undulating relief, where soil materials are in the silt loam textural class. These materials resemble loess in texture, but they tend to be stratified and they normally contain pebbles and stones of all sizes. The materials may be a silty till. A possible explanation of their origin, by Flint (*2*), follows:

> It seems likely that loess is eroded beneath a glacier by the rasping effect of large-sized rock fragments held in the base of the moving ice. A glacier flowing across a surface mantled with loess may erode the loess in this way; at the same time some of the large rock fragments are lodged in its upper part. With continued advance the supply of stones decreases, and the drift at the base of the ice includes an increasing proportion of plowed-up loess. Erosion of loess by the ice becomes increasingly difficult, with the result that upon deglaciation, some loess still remains beneath a covering of till having a matrix composed partly of loess.

In western Brookings County the Poinsett and its catenal associates are the soil series mapped in these silty materials.

The third distinctive association of land form and texture of materials of the Cary drift sheet occurs in the steep, round, flat-topped hills. These hills are separated by swamps or other low ground. The materials on the flat hilltops are in the silty clay or silty clay loam textural class, with a content of about 10 percent sand, 50 percent silt, and 40 percent clay. The steep sides have a loam or silt loam texture. A possible explanation is given by Flint (*2*).

> In Day County many cuts in areas of collapse topography show the Cary and post-Cary loess to be immediately underlain by parallel-bedded silt, apparently lacustrine. These relations imply that during retreat of the Cary glacier marginal temporary lakes developed, in part over buried Cary ice.

The Sinai soil series and its catenal associates occur on these flat-topped hills.

The Cary drift also occurs in the northeastern corner of Brookings County. Here the land form is undulating, except for the steep end moraine. A number of undrained depressions dot the landscape. The till in this area is a loam with a content of about 45 percent sand, 30 percent silt, and 25 percent clay. In this northeast area of Cary drift, the Singsaas series and its catenal associates occur.

In addition to glacial drift of the Iowan, Tazewell, and Cary ages, many areas of alluvium and outwash occur in the county. These areas are not shown separately on the geologic map (fig. 3), but they are shown on the general soil area map in the back of the report.

It is believed that most of the outwash of Brookings County is of Cary age and that Iowan and Tazewell outwash is buried beneath Iowan and Tazewell loess. Two great lobes of Cary ice discharged melt water into the Big Sioux at the same time. These discharges probably account for most of the outwash, because melt water from Mankato ice to the east is thought to have led to erosion rather than deposition (*2*). Part of the outwash of the county is mantled with loess and part with alluvium. The Estelline series and its catenal associates are mapped in the loess-mantled outwash, and the Fordville and its associates are mapped in the alluvium-mantled outwash. The Lamoure, Volga, and Rauville series are mapped in the alluvium.

The Big Sioux River is believed to have come into existence when two large ice lobes covered opposite sides of the Prairie Coteau and left a long narrow glacier-free strip, along which melt water could escape. This is thought to have occurred not later than Tazewell time. Early stream drainage in Brookings County was to the west or southwest. By tracing drift-buried valleys and using other evidence, Flint inferred that several major streams predated the Big Sioux River. These early stream valleys of Brookings County are shown in figure 4.

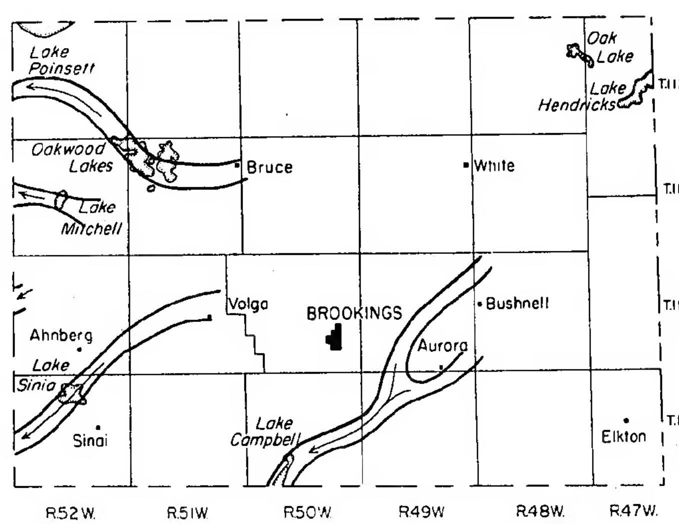

***Figure 4.*—Elements of the inferred prediversion drainage system in Brookings County.**

TABLE 1.—*Temperature data for the Brookings County area*[1]

Week	On the basis of records kept by two weather stations (Brookings, Brookings County, and Wentworth, Lake County, S. Dak.)[2]						
	Average weekly maximum temperatures	Average weekly mean temperatures	Average weekly minimum temperatures	Chance of at least one daily maximum temperature of 90° F.	Chance of at least one daily maximum temperature of 32° F.	Chance of at least one daily minimum temperature of 32° F.	Chance of at least one daily minimum temperature of 0° F.
	°F.	*°F.*	*°F.*	*Percent*[3]	*Percent*[3]	*Percent*[3]	*Percent*[3]
January:							
3 to 9	24.3	14.1	3.1		68	98	41
10 to 16	24.8	14.7	4.2		68	98	38
17 to 23	24.4	14.1	3.2		66	97	43
24 to 30	23.0	12.3	1.0		71	97	51
31 to Feb. 6	23.5	12.9	1.8		70	96	47
February:							
7 to 13	25.3	14.9	4.1		63	95	41
14 to 20	28.3	17.8	6.9		60	95	33
21 to 27	31.4	20.6	9.3		50	94	26
28 to 29	32.3	21.7	11.7		51	93	15
March:							
1 to 7	34.1	23.9	13.3		43	96	18
8 to 14	37.8	27.9	17.4		34	93	10
15 to 21	41.5	30.8	19.6		23	88	8
22 to 28	46.5	35.6	23.9		14	80	3
29 to April 4	48.6	38.0	26.7		9	75	1
April:							
5 to 11	52.6	41.2	29.5		3	67	
12 to 18	57.9	45.1	32.1	Less than 1	1	54	
19 to 25	61.6	48.7	35.4	Less than 1		39	
26 to May 2	63.2	51.0	38.2	1	1	28	
May:							
3 to 9	66.1	53.3	40.1	3	Less than 1	22	
10 to 16	67.2	54.6	41.6	2		14	
17 to 23	71.8	59.1	46.0	4		5	
24 to 30	73.6	61.3	48.4	5		4	
31 to June 6	74.5	62.8	50.5	8		1	
June:							
7 to 13	75.7	63.8	51.5	7		1	
14 to 20	79.2	67.5	55.3	10		Less than 1	
21 to 27	81.3	69.2	56.6	19			
28 to July 4	82.2	70.1	57.5	20			
July:							
5 to 11	83.6	71.4	58.6	21			
12 to 18	84.8	72.0	58.8	24			
19 to 25	85.6	72.5	59.1	28			
26 to Aug. 1	85.6	72.6	59.2	30			
August:							
2 to 8	83.9	71.4	58.3	23			
9 to 15	82.9	70.5	57.7	19			
16 to 22	82.8	69.8	56.5	16			
23 to 29	81.3	68.3	54.9	17			
30 to Sept. 5	80.8	67.6	53.9	16		Less than 1	
September:							
6 to 12	76.0	63.3	51.3	10		2	
13 to 19	73.6	61.6	47.8	5		5	
20 to 26	71.1	57.7	43.8	2		11	
27 to Oct. 3	69.0	55.6	41.8	1		15	
October:							
4 to 10	65.7	52.6	39.0	1		21	
11 to 17	63.6	50.6	37.2	Less than 1	Less than 1	31	
18 to 24	58.5	46.2	33.6	Less than 1	1	46	
25 to 31	54.2	42.1	29.7		4	59	Less than 1
November:							
1 to 7	50.2	38.9	26.9		8	69	Less than 1
8 to 14	43.0	32.5	21.7		19	83	3
15 to 21	41.8	31.6	21.1		22	86	5
22 to 28	36.9	27.1	16.8		32	92	8
29 to Dec. 5	34.0	24.3	14.1		41	92	16
December:							
6 to 12	29.6	20.1	10.5		54	97	24
13 to 19	26.3	16.8	6.9		65	97	31
20 to 26	27.7	17.7	7.0		59	96	30
27 to Jan. 2	25.9	15.5	4.4		63	97	37
Yearly average	55.7	44.1	32.1				

[1] Data compiled with the assistance R. F. PENGRA, Agricultural Economics Department, South Dakota State College; M. D. MAGNUSON, U. S. Weather Bureau; and and D. C. LOCKWOOD, Machine Records Service, South Dakota State College, under a joint project by the South Dakota State College Agricultural Experiment Station, the U. S. Reclamation Bureau, and the U. S. Weather Bureau.

[2] The Brookings record extends from 1893 to 1954; the Wentworth record extends from 1896 to 1954. Except from 1893 to 1895, when the Brookings record was used alone, the data of the records of these two stations were combined.

[3] Number of chances in 100 that event will occur. For example, the chance is less than 1 in 100 that 1 daily maximum temperature of 90° F. or more will occur during the week of April 12 to 18 in any year.

Climate

The climate of Brookings County is continental. Because the county is a great distance from a large body of water, temperature extremes are common. Moreover, this region is alternately influenced by air masses from northern regions and from the Gulf of Mexico. Therefore, seasonal and even daily fluctuations of temperature are great. Neither precipitation nor temperature, however, fluctuates as much in the county as in central and western South Dakota. Spring is moist, cool, and windy; summer is sunny and hot; autumn is dry, cool, and sunny; and winter is cold and relatively long. Temperature data for the Brookings County area are given in table 1.

The precipitation of autumn, winter, and spring in Brookings County is generally frontal precipitation. Such precipitation, some of which comes as snow, falls at a slow rate during relatively long periods, and each storm covers most of the county.

Summer precipitation is mostly of the thunderstorm type. The rains usually cover only a part of the county, but at times they may affect the whole county. They come as short hard showers that may be accompanied by strong winds and hail. Much of this type of rainfall is lost by runoff on the undulating to rolling soils of medium texture, especially if tilth is poor. Precipitation data for the Brookings County area are given in table 2.

Annually the Brookings County area normally receives about 2,700 hours of sunshine, and about 40 percent of the days are clear. About 70 percent of the days are sunny in summer, and 55 percent are sunny in winter. The county is in a region that has about 10 hailstorms during a growing season (*8*).

Native Vegetation

The county is in an area where the native vegetation was mainly short, mid, and tall grasses. The dominance of any of the three kinds of grass was determined by the soil, slope, and drainage of the site. Short and mid grasses prevailed on hilly medium-textured soils. Included species were blue grama, buffalograss, green needlegrass, needle-and-thread, and sideoats grama. Forbs such as silverleaf sage also grew on these soils. On sandy soils and on nearly level medium-textured soils, the tall and mid grasses dominated. Species included big and little bluestem, Canada wildrye, prairie sandreed, and sand dropseed. Among the forbs were silverleaf, scurfpea, and lupine. The poorly drained soils were sites of marsh vegetation.

Purpose and Methods of Soil Surveys

A soil survey consists of a map and a report. The map shows the distribution of soil units in relation to other features of the earth's surface. The report describes the soils shown on the map and makes statements about their behavior.

Purpose

The main purpose of a soil survey, like that of any other research, is to make predictions. Soils may vary greatly from place to place, even over one farm. They may be well drained or poorly drained, shallow or deep, sandy or clayey, rolling or level. These various kinds of soils behave differently and require different management for their best production. In itself, the study of the soils and their behavior does not constitute soils research. The knowledge gained from this study has little prediction value until the characteristics of the soils are cataloged by a system of soil classification. This classification system, coupled with the soil map, is the basis for reporting the results of research and experience for the fields of your farm.

How Soil Maps Are Made

Soil maps are made by actually observing the soils in the field. The boundaries between the different kinds of soils are plotted on aerial photographs by soil scientists. They walk across the fields and systematically observe the soil characteristics, not only at the surface but to depths of 60 inches or more. After the soils are classified and their boundaries plotted, they are correlated. Correlation consists of comparing the soil types mapped with those already defined in the nationwide system of classification. Where necessary new soils are established and named within the system.

Why Soils Have Names

Names help in remembering the characteristics of any object. All farmers are familiar with the names of breeds of livestock. These names call to mind the characteristics of these animals. It is the same with soils. Instead of describing a soil as deep dark-colored silt loam developed from windblown silt over glacial till, we can simply say Kranzburg silt loam. This name stands for all of the characteristics used in the classification of the soil. The name of the soil series is taken from some geographic feature near where the soil was first described. For example, the Brookings series was named after the town of Brookings.

Publication of Soil Surveys

The soil survey of Brookings County is made available to farmers and other users in two ways. This published report, with soil maps, description of soils, and information about soil management, is distributed on request to farmers in the county, to libraries, to agricultural workers. The South Dakota Agricultural Experiment Station and the Soil Conservation Service also prepared enlargements of the soil maps of individual farms at a scale of 8 inches to the mile. These, with brief descriptions of the soils and information about soil management, are available to farmers in the county.

TABLE 2.—*Precipitation data for the Brookings County area*[1]

Week	On the basis of records kept by two weather stations[2] (Brookings, Brookings County, and Wentworth, Lake County, S. Dak.)				
	Average weekly precipitation	Chance of at least one day with precipitation of 0.1 to 0.39 inch[3]	Chance of at least one day with precipitation of 0.4 to 0.99 inch[3]	Chance of at least one day with precipitation of 1 inch or more[3]	Average weekly new snow
	Inches	*Percent*[4]	*Percent*[4]	*Percent*[4]	*Inches*
January:					
3 to 9	0.10	23	5	1	0.92
10 to 16	.13	41	4	2	1.23
17 to 23	.10	26	2	1	1.00
24 to 30	.11	31	3	1	.98
31 to Feb. 6	.13	34	7	1	1.32
February:					
7 to 13	.11	24	6	-----	.97
14 to 20	.11	34	7	-----	1.24
21 to 27	.14	29	7	3	1.17
28 to 29	.03	7	2	-----	.30
March:					
1 to 7	.20	39	12	1	1.80
8 to 14	.16	45	9	1	1.29
15 to 21	.21	40	12	2	1.08
22 to 28	.30	57	21	2	1.15
29 to April 4	.28	46	10	5	.91
April:					
5 to 11	.38	57	23	6	.87
12 to 18	.46	69	32	7	.41
19 to 25	.59	82	37	12	.13
26 to May 2	.69	82	49	16	.25
May:					
3 to 9	.66	83	40	13	.05
10 to 16	.58	78	39	9	.12
17 to 23	.76	89	42	19	-----
24 to 30	.75	84	50	15	-----
31 to June 6	1.00	99	51	28	-----
June:					
7 to 13	.93	90	61	22	-----
14 to 20	.86	75	54	24	-----
21 to 27	.95	85	57	22	-----
28 to July 4	.78	82	50	20	-----
July:					
5 to 11	.60	69	45	10	-----
12 to 18	.49	68	33	9	-----
19 to 25	.73	59	39	20	-----
26 to Aug. 1	.63	59	40	15	-----
August:					
2 to 8	.66	73	35	18	-----
9 to 15	.76	67	49	19	-----
16 to 22	.56	64	35	12	-----
23 to 29	.57	50	37	12	-----
30 to Sept. 5	.45	58	29	8	-----
September:					
6 to 12	.78	72	42	21	-----
13 to 19	.57	53	45	10	-----
20 to 26	.47	57	21	12	.02
27 to Oct. 3	.31	34	22	5	.00
October:					
4 to 10	.46	50	30	12	.00
11 to 17	.27	58	14	3	.06
18 to 24	.29	44	14	7	.34
25 to 31	.24	40	16	4	.20
November:					
1 to 7	.22	41	16	3	.47
8 to 14	.21	38	17	-----	.63
15 to 21	.19	25	16	2	.69
22 to 28	.11	28	7	-----	.58
29 to Dec. 5	.14	33	7	1	.99
December:					
6 to 12	.10	25	5	-----	.69
13 to 19	.09	27	2	1	.90
20 to 26	.11	35	5	-----	1.01
27 to Jan. 2	.11	31	3	-----	.85
Total	21.62				

[1] Data compiled with the assistance of R. F. PENGRA, Agriculture Economics Department, South Dakota State College; M. D. MAGNUSON, U. S. Weather Bureau; and D. C. LOCKWOOD, Machine Records Service, South Dakota State College, under a joint project by the South Dakota State College Agricultural Experiment Station, the U. S. Reclamation Bureau, and the U. S. Weather Bureau.

[2] The Brookings record extends from 1893 to 1954; the Wentworth record extends from 1896 to 1954. Except from 1893 to 1895, when the Brookings record was used alone, the data of the records of these two stations were combined.

[3] Includes both rain and snow.

[4] Number of chances in 100 that event will occur. For example, the chance is 69 to 100 that, during the week of April 12 to 18, at least 1 day will have a total precipitation of 0.1 to 0.39 inches.

Soils of Brookings County[3]

In this section the soils of Brookings County are classified, their general location in the county is given, and their profiles and landscapes are described.

Classification System

The object of any system of classification is to group units that have similar characteristics. This principle is followed in the system of soil classification generally used throughout the United States. Later this system may be refined, and probably most of the changes will be in the higher categories.

The basic unit of the classification system is the soil type. Soil types are grouped into soil series, which, in turn, are grouped into soil families. Successively higher categories are great soil groups, suborders, and orders. The higher the category, the fewer precise statements can be made about the included units. The higher units are most useful, however, in understanding the relationships among soils. In this report the great soil group is the highest category considered.

The great soil group has been subdivided from a higher category on the basis of kind and arrangement of soil horizons. All soils in a great soil group must have the same kinds of horizons similarly arranged in the profile. The degree to which these horizons are expressed and some subordinate properties of these horizons may vary within a great soil group.

The soil family has not been precisely defined in our present system of classification, but it is used in this report to attempt to bridge the gap between great soil group and series. Each great soil group represented in Brookings County has been subdivided into families on the basis of the degree of expression of genetic horizons modal for the group. A soil family represents: (1) a modal profile, or central concept, for the great soil group; or (2) a profile that intergrades to another great soil group. Within a family the soil parent material, texture, stoniness, slope, erosion, soil depth, or other characteristics can vary. These characteristics are used to differentiate classes at lower levels. The soil family name is taken from the name of one of the prominent soil series in the family.

Soil families are subdivided into soil series on the basis of differences in parent material and minor differences in the profile. Soil series, in turn, are subdivided into soil types on the basis of texture of the surface soil. Lastly, types are subdivided into phases on the basis of depth, slope, degree of erosion, and other characteristics that are important in problems of land use and management.

The soils series of Brookings County are classified by higher categories in table 3.

TABLE 3. — *Classification of soils of Brookings County, S. Dak., into great soil groups, families and series*

Great soil group	Family	Series
Regosol	Sioux	Sioux. Pierce.
	Buse	Buse. Dickey. Hecla. Maddock.
Chernozem	Vienna	Vienna. Lismore. Singsaas. Oak Lake. Ahnberg. Poinsett. Waubay. Sinai. Fordville. Renshaw. Kranzburg. Brookings. Flandreau. Estelline. Moody. Egeland.
	Athelwold	Athelwold.
	Oldham	Oldham. Hidewood. Lamoure.
Humic Gley	Parnell	Parnell. Leota. Solomon. Volga. Rauville.
Soloth	Tetonka	Tetonka.

[3] Section written by G. J. BUNTLEY, assistant agronomist, and F. C. WESTIN, agronomist, South Dakota State College.

Great soil groups and families

The great soil groups of Brookings County are Regosol, Chernozem, Humic Gley, and Soloth.

The term Regosol is used for deep unconsolidated deposits other than recent alluvium that have little or no profile development. In Brookings County, Regosols have A horizons but no B horizons and were derived from outwash or glacial till. The Regosol great soil group has been subdivided into two families, the Sioux and the Buse. The Sioux family is the central concept of the Regosol. The Buse family is an intergrade between the Regosol and Chernozem great soil groups because of the presence of a B horizon of weak structure, texture, or color.

The name Chernozem is taken from a Russian word meaning black earth. Chernozems have black or nearly black A horizons. Their B horizons have a prismatic structure and normally a redder hue than the overlying or underlying horizons. The Chernozem great soil group in Brookings County has been subdivided into three families: Vienna, Athelwold, and Oldham. The Vienna family represents the central concept of the Chernozem great soil group in Brookings County. The Athelwold is a Chernozem-Prairie intergrade, and the Oldham is a Chernozem-Humic Gley intergrade.

Humic Gley soils have a thick, black A horizon that is high in humus. This horizon is underlain by a horizon of intense reduction that is characterized by the presence of ferrous iron and by neutral gray colors. The gray reduced horizon was formed by the process

of gleying, which involves saturation of the soil with water in the presence of organic matter. The Humic Gley group in Brookings County has only one family, the Parnell, which represents the central concept for the group.

Soloth soils have a black or nearly black A_1 horizon, a gray, platy A_2 horizon, and a columnar or prismatic B horizon. Although Soloth soils are free of soluble salts and very low in exchangeable sodium, these materials are thought to have affected their development. The Soloth great soil group in Brookings County includes one family, the Tetonka, which represents the central concept for the group.

Genesis and Morphology

Soil-forming factors

The kind of soil that develops in any given area depends on the interaction of five factors—climate, living organisms (chiefly vegetation), parent material, relief, and time. Climate and vegetation are considered the active factors of soil genesis or formation, and they alter the parent material in various ways. Parent material, relief, and time modify the influences of climate and vegetation.

A summary of the soil-forming factors in Brookings County follows. Any combination of these factors may occur.

Climate: Moist subhumid.

Vegetation: Tall, mid, and short grasses.

Parent material: Loess, glacial till, outwash, eolian sand, and alluvium.

Relief: Hilly, rolling, undulating, sloping, nearly level, and depressional.

Age: Iowan drift (about 18,000 to 20,000 years old) to recent alluvium.

The full effects of climate and vegetation on soil formation occur only on well-drained sites. These sites are usually undulating or sloping. Because of impeded drainage, soils in depressions are subject to reduction and to accumulation of the products of weathering and soil formation. Soils on steep slopes are excessively drained. They have such high runoff and erosion that very little organic accumulation, weathering, and translocation of material take place in the profile.

Soil formation on well-drained sites

In Brookings County, soils developed on well-drained sites are of the Chernozem great soil group. These soils have formed where rainfall is sufficient for a good growth of natural grasses but not sufficient to cause appreciable leaching, except of soluble salts and the bicarbonates of calcium and magnesium. The Chernozem profiles of the county have a slightly acid surface horizon, and normally a slightly alkaline subsoil and substratum. These soils have rather high cation exchange capacities and are saturated mainly with calcium. The clay minerals of the profile are of the expanding lattice type (*3*). The carbon-nitrogen ratio of the A_1 horizon is 12:1, and that of the B_2 horizon is 9:1.

In Brookings County the characteristics described in the preceding paragraph are best expressed in a well-drained Chernozem that developed in glacial till—Vienna loam. The other well-drained Chernozems in the county differ from the Vienna, at the series level, because they developed in a different parent material. Ahnberg soils developed in clay loam till; the Kranzburg in loess over till; the Estelline in loess over outwash; the Flandreau in loess over sand; and the Fordville and Renshaw in alluvium over gravel. These soils, however, are Chernozems and have Chernozem characteristics.

Some of the well drained Chernozems have moderately well drained associates that also are Chernozems. The Vienna is associated with the moderately well drained Lismore, the Kranzburg with the moderately well drained Brookings, and the Estelline with the moderately well drained Athelwold. These Chernozems are somewhat darker and deeper than the well-drained Chernozems.

The well-drained Singsaas soils and their moderately well drained associates of the Oak Lake series were derived from a loam till. The soils of both series differ from the other Chernozems in that their horizons have been intensively mixed by worm action.

Soil formation on hilly sites or in coarse materials

The influence of relief dominates the influence of climate and vegetation on steep or hilly sites and on level areas of coarse gravelly materials. On the steep or hilly sites runoff is high and percolation low; on very coarse materials of more nearly level areas, percolation is very rapid. Under either condition, plant growth is restricted and organic accumulation is slight. A thin soil results. In Brookings County the soils that occur on hilly sites or in coarse materials have developed in glacial drift. They are classified as Regosols.

The Regosols are of the following series: (1) the Sioux, developed in very coarse gravelly outwash on terraces; (2) the Pierce, developed in coarse morainic outwash; (3) the Buse, developed in till on hilly sites; and (4) the Dickey, Hecla, and Maddock, developed in very sandy materials. Pierce loam (see fig. 31) is a good example of a Regosol. Soils of the Buse, Dickey, Hecla, and Maddock series have a weak B horizon, and they are therefore classified as Regosol-Chernozem intergrades.

Soil formation on poorly drained sites

Two great soil groups of poorly drained soils occur in depressions or on flats having no surface drainage and slow internal drainage. These groups are the Humic Gley and the Soloth. The development of these soils is conditioned by the relief, which causes ponding.

When ponding occurs during the genesis of Humic Gley soils, micro-organisms and plant roots soon use

up the available oxygen in the water. Conditions of reduction set in and chemical changes take place. The chemicals produced tend to reduce the number of bacteria in the soil and restrict the deep growth of roots. When the number of microorganisms is reduced, the rate of decomposition slows and organic matter accumulates in the surface horizon of Humic Gley soils. Furthermore, ponding prevents the products of weathering and soil formation from being removed. As a result the Humic Gley soils in Brookings County are alkaline and usually calcareous. Generally these soils are low in available phosphate.

The black, humic surface horizon and the light-gray gley horizon give Humic Gley soils a distinct color profile. Usually the gley horizon is mottled with yellow flecks of ferric hydroxide. These yellow flecks indicate small spots where oxidizing conditions still prevail.

The processes described occur in poorly drained Humic Gley soils, which are exemplified by the Parnell family. In the somewhat poorly drained soils these processes go on in a milder degree, and the soils have some characteristics that intergrade them to Chernozems. The Oldham family is an example of a Chernozem-Humic Gley intergrade.

Poorly drained soils that occur in areas containing an appreciable amount of soluble salts, especially of sodium salts, are saline or "alkali." Solonchak, Solonetz, solodized Solonetz, and Soloth soils are of this kind, but only the Soloth have been mapped in Brookings County. Soloth soils are thought to be descended from Solonchaks. The salts, but not the exchangeable sodium, were leached from the Solonchaks to form Solonetz soils, which have a dense columnar B horizon that is close to the surface. After the exchangeable sodium is leached from the Solonetz, a process called solodization takes place. In this process the upper part of the dense B horizon is alerted to a gray friable layer. After the gray horizon deepens at the expense of the B horizon and only a thin vestige of the B horizon remains, the soil is classed a Soloth. The Tetonka is the only soil series of the Soloth great soil group mapped in Brookings County.

General Soil Areas of Brookings County

The soil maps bound in the last part of this report are large scale maps of segments of the county. A map that shows the general soil areas of the entire county is at the back of the report. This generalized map will especially interest those concerned with the use of broad groups of soils. On this map the soils of the county have been grouped into seven general soil areas. The first five of these general areas have been subdivided to bring out important differences. A discussion of the general soil areas and the subdivisions follows.

Nearly level medium- to fine-textured soils of the bottom lands

The bottom lands of the Big Sioux River and its tributaries make up a general soil area. This area is nearly level, and contains soils that are intermittently to constantly wet. In most of the area the soils are somewhat poorly to poorly drained and medium to fine textured. Most of the alluvium of this general area is thought to be of glacial origin. Postglacial deposits are thin and fine grained because of the small gradients and the competence of the streams. Stream activity is negligible, except in the spring when overflow usually occurs and the lowest parts of the valley floors become swampy. This general area of the bottom lands consists of subdivisions 10 and 11.

Subdivision 10 contains the soils of the Lamoure, Solomon, and Rauville series, which are 42 inches or more to gravel. Subdivision 11 contains the Volga soils, in which gravel occurs at depths between 20 and 42 inches.

Nearly level medium-textured soils of terraces

This general soil area contains nearly level soils on both high and low terraces, and a few short, steep escarpments; all of the soils are underlain by gravel. The area consists of subdivision 20, 21, and 22. Subdivision 20 consists of the loess-mantled soils of the Estelline and Athelwold series that are deep to gravel. The Estelline soils are well drained, and the Athelwold moderately well drained. Subdivision 21 contains the alluvium-mantled terrace soils of the Fordville, Renshaw, and Sioux series. These soils are well to excessively drained. The Fordville soils are moderately deep to gravel, the Renshaw shallow to gravel, and the Sioux soils very shallow to gravel. Subdivision 22 contains the sandy soils of low terraces. These soils occur mainly along the east side of the Big Sioux Valley. They are the sandy loam and loam of the Hecla series.

Gently sloping to sloping medium-textured soils of the central upland

This general soil area consists of gently sloping to sloping soils of the central upland. These soils are mainly of a medium texture. They occur on the Iowan and Tazewell glacial drift sheets. The area consists of broad ridgetops and of side slopes that end in drainageways. There are no closed depressions; all streams form an integrated system that drains into the Big Sioux River and its tributaries. This major area consists of subdivisions 30, 31, and 32.

Subdivision 30 contains the loess-mantled till soils of the Kranzburg, Brookings, and Hidewood series. The Kranzburg soils are well drained, the Brookings moderately well drained, and the Hidewood somewhat poorly drained. Subdivision 31 consists of soils that have developed directly in loam glacial till. These soils are of the Vienna, Lismore, and Leota series. The Vienna soils are well drained, the Lismore moderately well drained, and the Leota somewhat poorly drained. Subdivision 32 contains sandy loams of the Egeland series, loamy sands of the Maddock and Dickey series, and light loams of the Flandreau series.

Gently undulating, undulating, and rolling soils of the western upland

The gently undulating to rolling soils of the western upland make up this general soil area. These soils occur on the western Cary drift sheet of Brookings County on several types of land form, each with a characteristic soil texture. This general area consists of subdivisions 40, 41, 42, and 43.

Subdivision 40 contains soils developed in silty drift in a gently undulating or undulating landscape made up of a series of round-topped hills and intervening depressions. Soils of the Poinsett and Waubay series are in this subdivision. The Poinsett soils occur on the well-drained undulating positions, and the Waubay soils in lower, moderately well drained positions. Subdivision 41 consists only of the Sinai soils. These soils occur on the tops of flat-topped, steep-sided hills. They are silty clay loam or silty clay in texture and apparently have developed in lacustrine or water-laid sediments.

Subdivision 42 consists of Ahnberg and Poinsett soils, occurring in complex. The Ahnberg soils developed in a clay loam till that apparently is older than the silty drift parent material of the associated Poinsett soils. The clay loam till is thought to have been exposed by differential geologic erosion of the overlying silty drift. Some stream drainage has developed, and the slopes generally are smoother in this subdivision than in subdivisions 40, 41, and 43.

Subdivision 43 has rolling terrain, where the Buse, Pierce, and Poinsett soils occur together as complexes of intimately associated series. The landscape consists of a series of bare knobs that are interspersed in gentler relief and are usually steep sided. The Buse and Pierce soils are thin. They occur on the knobs. The deeper Poinsett soils occupy the gentler relief.

Gently undulating, undulating, and rolling soils of the northeast upland

This general soil area consists of gently undulating to rolling soils. The soils of this area have developed in the Cary drift of northeastern Brookings County. They differ from the other upland soils of the county in having soil horizons that are thoroughly mixed by earthworms. This general area consists of subdivisions 50 and 51.

Subdivision 50 contains the Singsaas and Oak Lake soils, which have developed on the gently undulating to undulating relief. This landscape is composed of swell- and-swale topography. The Singsaas soils occur on the well-drained swells, and the Oak Lake soils in the moderately well drained swales. Closed depressions are common in the landscape.

Subdivision 51 consists of undulating to rolling landscapes of soil complexes. These complexes consist of soils of the Buse, Pierce, and Singsaas series, which occur together on knobs and hills and in the interspersed areas of gentler relief. The Buse and Pierce soils occupy the knobs and hills, and the Singsaas soils occur on areas of less relief.

Soils of the depressions

The marshland and the low-lying depressional soils of the Parnell, Oldham, and Tetonka series are in soil area 60, which has not been subdivided. The Oldham and Tetonka soils are somewhat poorly drained, the Parnell soils are poorly and very poorly drained, and the marshland is very poorly drained. All of these soils occupy closed depressions.

Hilly or steep lands

The thin soils of the hilly or steep lands of the county are in soil area 70, which has not been subdivided. This area is dominated by Buse and Pierce soils. The Buse soils have developed from glacial till, and the Pierce, from gravelly, stony drift.

Descriptions of Soil Series and Soil Mapping Units

This section and the detailed soil maps contain the basic data of the soil survey of Brookings County. Interpretations for agriculture, engineering, or other uses must be based on this information.

The material in this section is arranged around the soil series. A broad description of the series is followed by a detailed description of a profile that typifies the series. Then each mapping unit is discussed in relation to the representative profile. Landscape characteristics are also given. The mapping unit is a soil type, a soil phase, or a soil complex.

The series is named for some geographic feature near the place where a soil of the series was first described. An example is the Brookings series, which was named for the town of Brookings. Soil types and phases make up a soil series. The soil type is named by adding the texture of the surface soil to the series name. Brookings silty clay loam is a soil type. A soil phase is a subdivision of a soil type made on the basis of a characteristic important in land use, although the characteristic may not pertain to the profile. Because slope is important in the use of Kranzburg silt loam, areas of this soil that have different slopes were mapped separately. We have, therefore, Kranzburg silt loam, nearly level; Kranzburg silt loam, gently sloping; and Kranzburg silt loam, sloping. The slope terms used in this report for simple and complex slopes of different gradient are as follows:

Percent slope	*Simple slopes*	*Complex slopes*
0 to 2	Nearly level	Nearly level.
3 to 4	Gently sloping	Gently undulating.
5 to 8	Sloping	Undulating.
9 to 18	Steeply sloping	Rolling.
Greater than 18	Steep	Hilly.

The soil complex is an association of two or more mapping units that occur together in such an intricate pattern that they cannot be shown separately on a map of the scale used.

The acreage and proportionate extent of the soil types, phases, and complexes are listed in table 4.

TABLE 4.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Ahnberg-Poinsett complex, gently undulating	986	0.2	Marsh	9,381	1.8
Ahnberg-Poinsett complex, undulating	1,290	.3	Moody silt loam, nearly level	2,537	.5
Athelwold silty clay loam, nearly level	2,664	.5	Moody silt loam, gently sloping	1,469	.3
Brookings silty clay loam, nearly level	9,796	1.9	Oak Lake silt loam, nearly level	1,956	.4
Brookings silty clay loam, drainageways	9,787	1.9	Oak Lake silty clay loam, drainageways	2,835	.6
Buse complexes, undulating	1,400	.3	Oldham silty clay loam, nearly level	9,489	1.9
Buse complexes, rolling	4,482	.9	Parnell silty clay loam, nearly level	5,613	1.1
Buse complexes, hilly	7,479	1.5	Pierce complexes, hilly	1,422	.3
Buse stony complexes, undulating	341	.1	Poinsett silt loam, nearly level	5,111	1.0
Buse stony complexes, rolling	1,162	.2	Poinsett silt loam, gently undulating	39,167	7.6
Dickey sandy loam, gently undulating	842	.2	Poinsett silt loam, undulating	25,426	4.9
Dickey sandy loam, undulating	190	(1)	Poinsett-Buse-Pierce soils, gently undulating	736	.1
Egeland sandy loam, nearly level	638	.1	Poinsett-Buse-Pierce soils, undulating	10,046	1.9
Egeland sandy loam, gently undulating	460	.1	Poinsett-Buse-Pierce soils, rolling	6,755	1.3
Egeland sandy loam, deep over loamy drift, nearly level.	2,046	.4	Rauville silty clay loam, nearly level	720	.1
			Renshaw sandy loam, nearly level	2,578	.5
Egeland sandy loam, deep over loamy drift, gently undulating.	1,087	.2	Renshaw sandy loam, gently sloping	750	.2
			Sinai silty clay loam, nearly level	2,762	.5
Estelline silt loam, nearly level	22,335	4.4	Sinai silty clay loam, gently sloping	5,120	1.0
Estelline silt loam, gently sloping	1,261	.3	Sinai silty clay loam, sloping	1,090	.2
Estelline silt loam, moderately shallow, nearly level.	7,314	1.3	Singsaas loam, gently undulating	6,255	1.2
			Singsaas loam, undulating	2,781	.5
Estelline silt loam, moderately shallow, gently sloping.	950	.2	Singsaas-Buse loams, gently undulating	3,233	.6
			Singsaas-Buse loams, undulating	707	.1
Flandreau silt loam, nearly level	903	.2	Singsaas-Buse-Pierce loams, undulating	677	.1
Flandreau silt loam, gently sloping	656	.1	Singsaas-Buse-Pierce loams, rolling	760	.2
Flandreau silt loam, deep, nearly level	858	.2	Sioux gravelly loam, gently undulating	250	.1
Flandreau loam, deep, nearly level	1,211	.2	Solomon clay, nearly level	17,043	3.3
Flanreau loam, deep, gently undulating	210	(1)	Terrace escarpments, sloping	1,580	.3
Flandreau loam, deep over till, nearly level	750	.2	Tetonka silty clay loam, nearly level	340	.1
Flandreau loam, deep over till, gently sloping	1,511	.3	Vienna loam, nearly level	23,614	4.6
Flandreau loam, deep over till, sloping	770	.2	Vienna loam, gently sloping	25,312	4.9
Fordville loam, nearly level	18,583	3.6	Vienna loam, sloping	13,583	2.7
Fordville loam, gently undulating	2,208	.4	Vienna sandy loam, gently undulating	893	.2
Fordville loam, thick solum, nearly level	7,149	1.4	Vienna sandy loam, undulating	509	.1
Fordville loam, deep, nearly level	839	.2	Vienna-Buse loams, gently undulating	440	.1
Fordville sandy loam, nearly level	1,070	.2	Vienna-Buse loams, undulating	3,308	.7
Fordville sandy loam, gently undulating	200	(1)	Vienna-Buse loams, steep	440	.1
Hecla loam, undulating	1,593	.3	Vienna-Buse-Pierce loams, undulating	707	.1
Hecla sandy loam, nearly level	3,908	.8	Vienna-Buse-Pierce loams, rolling	630	.1
Hidewood silty clay loam, nearly level	1,935	.4	Volga loam, somewhat poorly drained, nearly level.	2,712	.5
Kranzburg silt loam, nearly level	21,261	4.2			
Kranzburg silt loam, gently sloping	15,997	3.1	Volga silty clay loam, somewhat poorly drained, nearly level.	18,090	3.5
Kranzburg silt loam, sloping	5,052	1.0			
Kranzburg loam, nearly level	1,695	.3	Volga silty clay loam, poorly drained, nearly level.	6,797	1.3
Kranzburg loam, gently sloping	390	.1			
Lamoure silty clay loam, nearly level	38,936	7.5	Waubay silty clay loam, nearly level	1,496	.3
Leota silty clay loam, nearly level	1,560	.3	Waubay silty clay loam, drainageways	14,085	2.8
Lismore silty clay loam, nearly level	6,296	1.2	Gravel Pits	224	.1
Lismore silty clay loam, drainageways	11,063	2.2	Lakes	7,211	1.4
Maddock sandy loam, nearly level	696	.1			
Maddock sandy loam, undulating	190	(1)	Total	512,640	100.0

[1] Less than 0.1 percent.

Ahnberg series

The Ahnberg soils in Brookings County are well-drained Chernozems. They have developed under tall and mid grass associations in calcareous firm glacial till of clay loam texture. These soils occur on gently undulating and undulating uplands.

The Ahnberg soils have a black or very dark brown, friable, granular A_1 horizon. This horizon is clearly transitional to the B_2 horizon, which is very dark grayish brown, firm, and of strong prismatic and blocky structure. The B_2 horizon shows thick, continuous clay skins. It is underlain by a dark grayish-brown, firm, strongly developed B_{3ca} horizon that has thick, continuous clay skins and segregated white-eye lime and disseminated lime in quantity. The B_{3ca} horizon grades into a C_{ca} horizon of firm grayish-brown and white clay loam glacial till that overlies a less calcareous C horizon of the same materials.

In Brookings County the loam texture usually predominates in the Ahnberg soils, but silt loam and clay loam textures also occur. The Ahnberg soils are mapped only in complex with the Poinsett soils. In association with the Poinsett soils, they usually developed in a superficial smear of friable, stratified, silty glacial drift over a firm basal till. They differ from

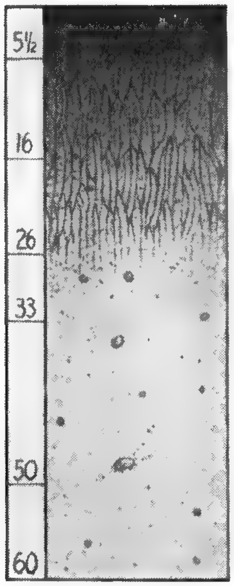

Figure 5.—**Ahnberg loam.**

the Beadle and Raber soils of drier regions, which are not mapped in Brookings County. They are distinguished from associated soils by the strong structure and distinct texture of the B horizon and by the large white-eye lime segregations in firm clay loam glacial till.

Most areas of Ahnberg soils are used for small grains, corn, and alfalfa.

Following is a profile description of Ahnberg loam (fig. 5):

A_{1p} 0 to 5½ inches, very dark gray (1Y 3/1.5, dry) to black (10YR 2/1.5, moist), very friable, noncalcareous loam; weak fine crumb structure; lower boundary clear and smooth.

B_2 5½ to 16 inches, dark grayish-brown (2.5Y 4/2, dry) to very dark grayish-brown (10YR 3/2, moist), firm, noncalcareous clay loam; moderate to strong medium and coarse prismatic structure that breaks to fine prismatic and, in turn, to moderate medium blocky; thick continuous clay skins on faces of peds; clay skins are about the same color as those in the next layer below; lime splotches inside the peds as described in the next horizon mark the clear but irregular lower boundary.

B_{3ca} 16 to 26 inches, grayish-brown and white (2.5Y 5.5/2 and 8/0, dry) to dark grayish-brown and white (1Y 4/2 and 8/0, moist) clay loam; contains many large, soft, white-eye lime segregations; firm; moderately calcareous; moderate to strong medium and fine prismatic structure that breaks to moderate fine and medium blocky; thick continuous clay skins on faces of peds; lower boundary smooth.

C_{ca} 26 to 33 inches, grayish-brown and white (2.5Y 5.5/2 and 8/0, dry) to dark grayish-brown and white (2.5Y 4/2.5 and 8/0, moist) clay loam glacial till; contains common, medium, soft, white-eye lime segregations; friable; strongly calcareous; massive structure; lower boundary smooth.

C_1 33 to 50 inches, light brownish-gray, light yellowish-brown, yellowish-brown, and white (2.5Y 6/2, 6/2.5, 10YR 5/8, and 8/0, dry) to light olive-brown, yellowish-brown, and white (2.5Y 4.5/4, 10YR 5/8, and 8/0, moist) clay loam glacial till; contains common shale chips and a very few small, soft lime segregations; friable to firm; moderately calcareous; massive structure.

C_2 50 to 60 inches, light brownish-gray, light yellowish-brown, yellowish-brown, and white (2.5Y 6/2, 6/2.5, 10YR 5/8, and 8/0, dry) to light olive-brown, yellowish-brown, and white (2.5Y 4.5/4, 10YR 5/8, and 8/0, moist) clay loam glacial till; contains common shale chips; friable to firm; moderately calcareous; massive structure.

Location of profile: Sec. 25, T. 110 N., R. 52 W.; 0.45 mile S. and 500 feet E. of the W. ¼ corner.[4]

Ahnberg-Poinsett complex, gently undulating (3 to 4 percent slopes) (Aa; subgroup 2C)[5].—This complex consists of two well-drained soils—Ahnberg loam, gently undulating, and Poinsett silt loam, gently undulating. The Ahnberg soil has developed in a thin mantle of friable, stratified, silty glacial drift over a firm basal till. The Poinsett soil has developed in 5 feet or more of friable, stratified, silty glacial drift. This complex is composed of about equal parts of the two soils. It occurs near the town of Ahnberg (soil area 42).

The two soils occur together in no set pattern. The relief of the general area of the complex, however, is somewhat subdued and has a fairly well developed pattern of integrated drainage that is not characteristic of the other areas of Cary drift in the county.

Ahnberg-Poinsett complex, undulating (5 to 8 percent slopes) (Ab; subgroup 3B).—This complex consists of two well-drained soils—Ahnberg loam, undulating, and Poinsett silt loam, undulating. The Ahnberg soil has developed in a thin mantle of friable, stratified, silty glacial drift over a firm basal till. The Poinsett soil has developed in 5 feet or more of friable, stratified, silty glacial drift. Except that its surface horizons normally are slightly thinner, this unit is similar in profile to Ahnberg-Poinsett complex, gently undulating. Furthermore, it occupies similar positions and has about the same ratio of Ahnberg and Poinsett soils. This complex occurs in soil area 42.

Athelwold series

Only one Athelwold soil—Athelwold silty clay loam, nearly level—is mapped in Brookings County. It is a moderately well drained Chernozem-Prairie intergrade. The soil was developed under tall and mid grass associations in 24 to 60 inches of calcareous, medium-textured loess, which overlies coarse, commonly stratified sand, mixed sand and gravel, and gravel outwash, or any of these materials.

The soil has a thick, dark-gray to black silty clay loam A_1 horizon that grades into a B_2 horizon of dark grayish-brown, mottled silty clay loam of a weak to moderate prismatic and blocky structure. The B_2 horizon grades into a lighter colored, mottled, weakly developed silt loam B_3 horizon that grades, in turn, into a C horizon of mottled, massive, noncalcareous light silt loam. The C horizon grades into a D horizon of multicolored, noncalcareous, sand- and-gravel outwash. In Brookings County the texture of the Athelwold soil is mostly silty clay loam, but silt loam and silty clay

[4] A ¼ corner of a section is the midpoint of a side of the section. Therefore, the W. ¼ corner of section 25 is the midpoint of the west side of section 25.

[5] The letter symbol (Aa) designates the mapping unit as shown on the detailed soil map; the arabic number and capital letter (2C) designates the management subgroup in which the soil has been placed.

loam textures occur. Athelwold soils modally are not calcareous in the C horizon, but they may be calcareous in the D horizon.

The Athelwold soil is a moderately well drained catenal associate of the well-drained Estelline soils, which are Chernozems, and the somewhat poorly drained Hatfield soils, which are Humic Gleys. The Hatfield soils are not mapped in this county. The Athelwold soil differs from the Fordville and Wessington soils in having developed in silty loess instead of gritty water-laid materials and in being moderately well drained instead of well drained. The Wessington soils are not mapped in Brookings County. The Athelwold soil also differs from the moderately well drained Spottswood soils of drier regions in being developed in silty loess rather than in gritty water-laid materials.

The Athelwold soil is used primarily for corn, small grains, and alfalfa, but some areas are in pasture and hay.

Following is a profile description of Athelwold silty clay loam (fig. 6):

A_{1p} 0 to 6 inches, dark-gray (1Y 4/1, dry) to black (10YR 2/1, moist), soft, noncalcareous silty clay loam; weak to moderate fine granular and fine crumb structure; lower boundary smooth.

AB 6 to 12 inches, dark-gray to dark grayish-brown (1Y 4/1.5, dry) and black to very dark brown (10YR 2/1.5, moist), soft, noncalcareous light silty clay loam; weak medium and coarse prismatic structure that breaks to weak to moderate fine granular; lower boundary smooth.

B_{21} 12 to 17 inches, dark-gray mottled with dark grayish brown, (10YR 4/1 and 4/2, dry) and black to very dark brown mottled with very dark brown (10YR 2/1.5 and 2/2, moist) silty clay loam; soft to slightly hard; noncalcareous; weak to moderate medium prismatic structure that breaks to fine prismatic and, in turn, to moderate fine and very fine subangular blocky; thin continuous and thick patchy clay skins on faces of structural peds; lower boundary clear and smooth.

B_{22} 17 to 30 inches, dark grayish-brown mottled with grayish brown (2.5Y 4/2 and 5/2, dry) and very dark gray mottled with dark grayish brown (10YR 3/1 and 4/2, moist) heavy silty clay loam; friable to firm; noncalcareous; weak to moderate medium structure that breaks to fine prismatic and, in turn, to moderate fine and very fine subangular blocky; thin continuous and thick patchy clay skins on faces of peds; lower boundary smooth.

B_3 30 to 36 inches, light yellowish-brown, mottled with grayish brown (2.5Y 6/3 and 5/2, dry) to olive-brown mottled with very dark grayish brown (2.5Y 4/3 and 3/2, moist), silt loam; friable to firm; noncalcareous; weak medium prismatic structure that breaks to weak to moderate fine and very fine subangular blocky; thin, very patchy clay skins on faces of structural peds decrease with horizon depth; lower boundary smooth.

C 36 to 54 inches, light-gray, mottled with brownish yellow (5Y 7/2 and 10YR 6/6, dry) to olive-gray mottled with yellowish brown (5Y 5/2 and 10YR 5/6, moist), light silt loam; friable to firm; noncalcareous massive structure; lower boundary smooth.

D 54 to 60 inches, multicolored, noncalcareous, loose sand-and-gravel outwash.

Location of profile: Sec. 12, T. 109 N., R. 51 W.; 75 feet N. and 50 feet E. of the W. 1/4 corner.

Athelwold silty clay loam, nearly level (0 to 2 percent slopes) (Ac; subgroup 6B).—This soil has developed in loess that is 24 to 60 inches deep. It occurs on nearly level, broad stream terraces and outwash plains (soil area 20).

In its broad association with the well-drained Estelline soils, the Athelwold soil occupies two characteristic positions: (1) the more nearly level or, in places, slightly depressed terrace flats; and (2) the slightly to moderately depressed crisscrossed channels and drainageways of the natural drainage net, which is only superficially impressed into the nearly level terraces.

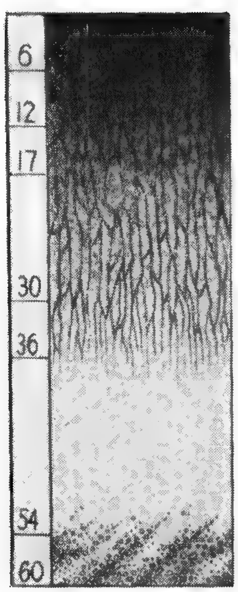

Figure 6.—**Athelwold silty clay loam.**

Brookings series

The Brookings soils are moderately well drained Chernozems that have developed under tall grasses in about 20 to 40 inches of calcareous silty clay loam loess that overlies early Wisconsin (Iowan-Tazewell) glacial till. In their broad association with the well-drained Kranzburg soils, the soils occur in the uplands on level to nearly level flats (fig. 7) and in the

Figure 7.—**Brookings and Kranzburg soils on Iowan drift surface.**

higher ends of the slightly depressed, well-developed dendritic drainage pattern that occurs in the Iowan and Tazewell landscapes.

The Brookings soils have a moderately thick to thick, black, friable, granular A_1 horizon. Their prismatic B horizon shows some worm working and is very dark grayish brown and friable. It overlies a horizon of disseminated and segregated calcium carbonate in light olive-gray parent loess or in the underlying till substratum, or in both.

The Brookings soils are the moderately well drained members of the Kranzburg-Brookings-Hidewood catena. In Brookings County the silty clay loam texture predominates in the Brookings soils, but silt loam and silty clay loam textures occur. The degree of horizonation varies with the amount of worm working. Worm working ranges from slight to moderate, the modal condition being somewhat less than moderate.

The Brookings soils differ from the Waubay soils of the Poinsett-Waubay catena in being developed in loess instead of stratified silty glacial drift.

Most areas of this soil are used for corn, small grains, and alfalfa.

Following is a profile description of Brookings silty clay loam (fig. 8):

A_{1p} 0 to 7½ inches, very dark gray (10YR 3/1, dry) to black (1Y 2/1, moist), friable, noncalcareous silty clay loam; cloddy to weak fine granular structure; boundary of horizon obscured by extensive worm working.

A_{11} 7½ to 13 inches, gray (10YR 5/1, dry) to black (10YR 2/1, moist), friable, noncalcareous silty clay loam; weak coarse prismatic structure that breaks to weak fine and very fine blocky; boundary of horizon obscured by worm working.

B_2A_1 13 to 17 inches, dark grayish-brown silty clay loam mottled with worm casts and filled worm channels of very dark gray (2.5Y 4/2 and 10YR 3/1, dry) to very dark gray and black (10YR 3/1 and 2/1, moist) silty clay loam; friable; noncalcareous; weak to moderate coarse prismatic structure that breaks to medium prismatic and, in turn, to weak to moderate fine and very fine blocky; thin, very patchy clay skins on faces of peds; boundary of horizon obscured by worm working.

B_2B_{3ca} 17 to 23 inches, dark grayish-brown silty clay loam mottled with worm casts and filled worm channels of grayish-brown (2.5Y 4/2 and 5/2, dry) to very dark grayish-brown and dark grayish-brown (2.5Y 3/2 and 4/2, moist) silty clay loam; friable; moderately calcareous; a few small lime segregations in casts and channel-fill material; weak to moderate coarse and medium prismatic structure that breaks to weak to moderate medium and fine blocky; thin, very patchy clay skins on faces of peds; boundary of horizon obscured by worm working.

C_{ca} 23 to 39 inches, light olive-gray to pale-olive mottled with white (5Y 6/2.5 and 8/0, dry) to olive mottled with white (5Y 5/3 and 8/0, moist) silt loam; friable; strongly calcareous; massive structure; few small lime segregations; lower boundary smooth.

D_{ca} 39 to 60 inches, light olive-gray mottled with white (5Y 6/3 and 8/0, dry) to grayish-brown to light olive-brown mottled with white (2.5Y 5/3 and 8/0, moist) loam glacial till; contains common lime segregations; firm; strongly calcareous; horizontal blocky structure.

Location of profile: Sec. 14, T. 109 N., R. 48 W.; 60 feet N. and 120 feet W. of blazed pole, 0.75 mile N. of the SE. corner.

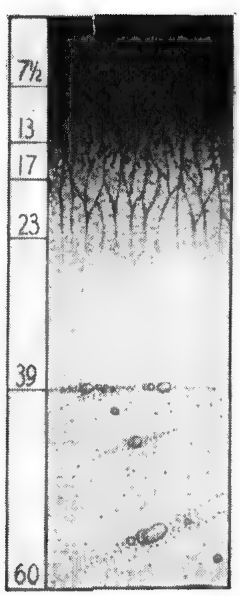

Figure 8.—**Brookings silty clay loam.**

Brookings silty clay loam, nearly level (0 to 2 percent slopes) (Ba; subgroup 1A).—This soil is a member of the same catena as the well-drained, generally more sloping Kranzburg soils and occurs above or below them on level to nearly level upland flats (soil area 30).

Brookings silty clay loam, drainageways (Bb; subgroup 1B).—This soil is in the same catena as the well-drained, more sloping Kranzburg soils and usually occurs below them in the upland drains of the well-developed drainage pattern (soil area 30). These drains are slightly depressed and are influenced by colluvium and alluvium. Where the gradient of the drains decreases, this soil occurs with the moderately well drained Brookings silty clay loam, nearly level, and with an unnamed Chernozen-calcium carbonate-Solonchak intergrade that has developed under the effect of a seasonal water table.

Brookings silty clay loam, drainageways, differs in position and general composition from Brookings silty clay loam, nearly level. The nearly level soil is more uniform in composition and occurs on level to nearly level upland flats above or below the well-drained Kranzburg soils.

Buse series

The Buse soils in Brookings County are thin, somewhat excessively drained Regosol-Chernozem intergrades. They have developed under mixed tall and mid grass associations, primarily in friable and firm glacial till that is of loam or clay loam texture, or both. They also occur in ice-contact-stratified drift (fig. 9).

The Buse series is the somewhat excessively drained member in the Poinsett catena, the Vienna catena, and the Singsaas catena.

Figure 9.—**Buse soils on slopes; Lamoure soil in valley. Southeastern tip of Lake Hendricks.**

In their catenal association with the Poinsett soils, the Buse soils have developed in silty stratified glacial drift and occur as rings on the steep side slopes around the undulations and hills, and as eroded ridge keels and knobs throughout the undulating and rolling parts of the landscape. They occur in association with the Pierce soils on morainic landscapes near the Poinsett soils. In these positions, however, they overlie ice-contact-stratified drift and are stony loams.

Buse soils normally are not cultivated. The somewhat less sloping areas that are in complex association with deeper soils are used for corn, small grain, and alfalfa.

The following profile description of Buse loam (profile A) (fig. 10) is representative of Buse soils that occur with Poinsett soils on the western lobe of the Cary drift in Brookings County.

A_{1p} 0 to 4 inches, grayish-brown (2.5Y 5.2, dry) to very dark grayish-brown (2.5Y 3/2, moist), soft to slightly hard, moderately calcareous loam; cloddy to weak fine granular structure; lower boundary clear and smooth.

B_{2ca} 4 to 20 inches, grayish-brown and white (2.5Y 5/2 and 8/0, dry) to very dark grayish-brown and white (2.5Y 3/2 and 8/0, moist), slightly hard, slightly calcareous loam; contains many medium and large soft lime segregations; weak coarse and medium prismatic structure that breaks to weak to moderate fine and medium blocky; moderate patchy clay skins on faces of peds; lower boundary wavy.

C_{ca} 20 to 32 inches, light brownish-gray and yellowish-brown (2.5Y 6/3 and 10YR 5/8, dry) to grayish-brown and yellowish-brown (2.5Y 5/3 and 10YR 5/8, moist), slightly hard, strongly calcareous loam glacial till; contains many medium and large soft lime segregations; very weak fine horizontal blocky structure; thin, very patchy clay skins decrease with depth; lower boundary irregular.

C 32 to 42 inches, light brownish-gray and yellowish-brown (2.5Y 6/3 and 10YR 5/8, dry) to grayish-brown and yellowish-brown (2.5Y 5/3 and 10YR 5/8 moist), soft to slightly hard loam glacial till; strongly calcareous; massive structure.

Location of profile: Sec. 24, T. 112 N., R. 52 W., 0.2 mile E. of NW. corner.

In their association with Vienna soils on Iowan drift, with Vienna soils on Tazewell drift, and with Singsaas soils on the eastern lobe of the Cary drift,

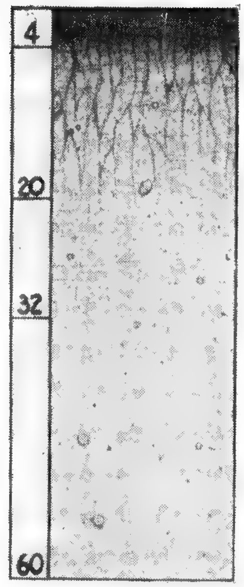

Figure 10.—**Buse loam (profile A).**

Buse soils vary considerably. These variations are primarily the result of differences in parent materials and in worm activity.

The Buse soils of the Vienna catena that occur on Iowan till have developed in massive loam-clay loam glacial till and show little if any worm working. The Buse soils of the Vienna catena that occur on Tazewell till have developed in clay loam glacial till of horizontal blocky structure and show slight worm working. The Buse soils of the Singsaas catena that occur on the eastern lobe of the Cary drift have developed in loam-clay loam glacial till and show moderate to strong worm working.

The following profile description of Buse loam (profile B) is representative of Buse soils that occur with the Vienna soils of the Tazewell drift and the Singsaas soils of the eastern Cary drift lobe.

A_1 0 to 4 inches, dark-gray to dark grayish-brown (10YR 4/1.5, dry) and very dark grayish brown (10YR 3/1, moist), friable, moderately calcareous loam; weak fine granular structure; gradual boundary obscured by worm working.

B_2A_1 4 to 8 inches, dark grayish-brown light clay loam mottled with worm casts of dark gray (10YR 4/2 and 4/1, dry), and very dark grayish-brown light clay loam mottled with worm casts of dark grayish brown (10YR 3/2 and 4/2, moist); friable; moderately calcareous; weak coarse and medium prismatic structure that breaks to moderate fine and medium subangular blocky; thin continuous and moderate patchy clay skins on both vertical and horizontal surfaces of peds; gradual boundary obscured by worm working.

B_{22} 8 to 15 inches, dark grayish-brown light clay loam mottled with worm casts of dark gray (1Y 4/2 and 10YR 4/1, dry), and very dark grayish-brown light clay loam mottled with worm casts of dark grayish brown (10YR 3/2 and 10YR 4/2, moist); friable; moderately calcareous; weak to moderate coarse and medium prismatic structure that breaks to moderate to strong fine and very fine subangular blocky; moderate continuous clay skins on vertical and horizontal surfaces of peds; gradual boundary obscured by worm working.

C_{ca1} 15 to 30 inches, pale-yellow to white, mottled with light gray (2.5Y 8/3 and 7/2, dry), and grayish-brown to light olive-brown and gray (2.5Y 5/3 and 5/1, moist), clay loam glacial till; friable to firm; strongly calcareous; moderate fine and medium horizontal blocky structure; thin continuous or moderate patchy clay skins on horizontal and vertical surfaces of structured till; slight amount of pseudomycelia lime segregation; lower boundary irregular.

C_{ca2} 30 to 45 inches, mottled light brownish-gray to light yellowish-brown, light-gray, and white (2.5Y 6/3, 7/0, and 8/0, dry) and dark grayish-brown to olive-brown, gray and light-gray (2.5Y 4/3, 6/0, and 7/0, moist) clay loam glacial till; firm; strongly calcareous; weak to moderate medium and coarse horizontal blocky structure; thin continuous clay skins on horizontal surface of structured till; few soft lime segregations.

C_{ca3} 45 to 60 inches, mottled light brownish-gray to light yellowish-brown, light-gray, white, and yellowish-brown (2.5Y to 6/3, 7/0, 8/0 and 10YR 5/8, dry), and grayish-brown to light olive-brown, gray, light-gray, and yellowish-brown (2.5Y 5/3, 6/0, 7/0, and 10YR 5/8, moist) clay loam glacial till; firm; moderately calcareous; weak medium horizontal blocky structure; thin, very patchy clay skins on horizontal surfaces of structured till; few, medium, soft lime segregations.

Location of profile: Sec. 23, T. 112 N., R. 48 W., 0.05 mile E. of SW. corner, midway between the roadside and the fence.

Buse complexes, undulating (5 to 8 percent slopes) (Bc; subgroup 5B).—This mapping unit is a complex of (1) a somewhat excessively drained, thin Buse soil developed in loam-clay loam glacial till or in stratified silty glacial drift; and (2) undifferentiated, deeper, normally well-drained soils that developed in various parent materials. The Buse soil occurs on the short, steep, generally eroded slopes and knobs and is surrounded by the undifferentiated deeper soils of less relief. This complex consists of about 35 percent Buse soil and 65 percent undifferentiated deeper soils. It occurs primarily in soil areas 40, 41, 42, and 43.

Buse complexes, rolling (9 to 18 percent slopes) (Bd; subgroup 4A).—This mapping unit is a complex of a somewhat excessively drained, thin Buse soil developed in loam-clay loam glacial till or in stratified silty glacial drift and undifferentiated, well-drained, deeper soils usually developed in similar materials. It occurs on eroded rolling morainic relief. It is about half Buse soil and about half undifferentiated deeper soils and is primarily in soil area 70.

Buse complexes, hilly (18 percent + slopes) (Be; subgroup 5D).—This mapping unit is a complex of a somewhat excessively drained thin Buse soil and undifferentiated, normally well-drained, deeper soils. The Buse soil and usually the undifferentiated soils were developed in loam-clay loam glacial till or in stratified silty glacial drift. The Buse soil occurs on steep, generally eroded slopes, knobs, and escarpments in a hilly morainic landscape. This landscape also includes somewhat smoother saddles, swales, and broader ridgetops on which the undifferentiated, deeper soils have developed. This complex consists of about 75 percent Buse soil and 25 percent undifferentiated deeper soils. It occurs mainly in soil area 70.

Buse stony complexes, undulating (5 to 8 percent slopes) (Bg; subgroup 5B).—This mapping unit consists of a somewhat excessively drained, stony, thin Buse soil and undifferentiated deeper soils that are normally well drained. The Buse soil developed in stony till or in stratified drift, and the undifferentiated soils developed in various parent materials. The Buse soil occurs on the short, steep, generally eroded slopes and knobs and is surrounded by the undifferentiated deeper soils of less relief. This unit is similar to Buse complexes, undulating, in landscape pattern and in percentage of soils that make up the unit. The two units differ, however, in that the Buse soil of Buse stony complexes, undulating, overlies ice-contact-stratified drift. It therefore has a profile that is quite stony and gravelly, especially in the upper part. Stones and pebbles tend to accumulate at the surface because of erosion. The unit occurs primarily in soil areas 40, 41, 42, and 43.

Buse stony complexes, rolling (9 to 18 percent slopes) (Bh; subgroup 4B).—This mapping unit consists of a somewhat excessively drained, stony, thin Buse soil and undifferentiated deeper soils that are normally well drained. The Buse soil developed in stony till or in stratified drift, and the undifferentiated soils developed in various parent materials. The Buse soil occurs on eroded, rolling morainic topography.

In relief and composition this complex is similar to Buse complexes, rolling. It differs, however, in that the Buse soil overlies ice-contact-stratified drift and has a profile that is quite stony and gravelly, especially in the upper part. Pebbles and stones tend to accumulate at the surface because of erosion. This unit occurs mainly in soil area 70.

Dickey series

The Dickey soils are well drained and somewhat excessively drained Regosol-Chernozem intergrades that developed under tall grasses. These soils occur on gently undulating and undulating uplands in fairly close association with the Maddock soils and in somewhat broader association with the Egeland and Flandreau soils. Dickey soils do not occur in any set pattern in the landscape or in relation to their associates.

The Dickey soils have a black, very friable sandy loam A_1 horizon that grades into a B_2 horizon of very dark grayish-brown to dark-brown, weakly developed loamy sand. The olive-brown, leached loamy sand C horizon grades into the D_{ca} horizon of firm, calcareous clay loam glacial till. Dickey sandy loams are the only Dickey soils mapped in Brookings County.

The Dickey soils differ from the Maddock soils in being underlain by glacial till at shallower depths. They are more coarse textured than the Egeland soils, and their solums are not in medium-textured loess like the Flandreau soils.

Most areas of this soil are used for small grains, corn, and alfalfa.

The following is a profile description of Dickey sandy loam (fig. 11):

A_1 0 to 3 inches, very dark grayish-brown (10YR 3/2, dry) and black (10YR 2/1, moist), very friable to loose, noncalcareous light sandy loam; weak fine granular and single-grain structure; lower boundary smooth.

A_1B_2 3 to 14 inches, very dark grayish-brown to dark grayish-brown (10YR 3.5/2, dry) and very dark brown and very dark grayish-brown (10YR 2.5/2, moist) loamy sand; very friable; noncalcareous; weak coarse prismatic structure that breaks to weak coarse and medium blocky; lower boundary irregular.

B_2 14 to 20 inches, dark grayish-brown (10YR 4/2, dry) and very dark grayish-brown to dark-brown (10YR 3/2.5, moist), very friable, noncalcareous, heavy loamy sand; weak to moderate coarse prismatic structure that breaks to weak coarse and medium blocky; a few moderate patchy clay skins on vertical ped surfaces, and clay between sand grains as bridges; lower boundary clear and smooth.

C 20 to 28 inches, grayish-brown to light olive-brown (2.5Y 5/3, dry) and dark grayish-brown to olive-brown (2.5Y 4/3, moist), loose loamy sand; noncalcareous; massive to single-grain structure.

C–D 28 to 31 inches, light olive-brown (2.5Y 5/5, dry) olive-brown (2.5Y 4/4, moist), loose to firm sandy loam; noncalcareous; massive to single-grain structure.

D_{ca} 31 to 52 inches, light brownish-gray to light yellowish-brown mottled with pale yellow and white (2.5Y 6/3, 7/4, and 8/0, dry) and grayish-brown to light olive-brown, olive-yellow, and white (2.5Y 5/3, 6/6, and 8/1, moist) stony clay loam glacial till; firm; strongly calcareous; massive; till contains common, medium, soft lime segregations.

D 52 to 60 inches, light yellowish-brown mottled with olive yellow (2.5Y 6/4 and 6/6, dry) and light olive brown (2.5Y 5/4 and 5/6, moist) clay loam glacial till that is less stony than the layer above; very firm; strongly calcareous; massive.

Location of profile: Sec. 21, T. 112 N., R. 50 W.; 0.35 mile N. and 50 feet E. of SW. corner.

Dickey sandy loam, gently undulating (1 to 3 percent slopes) (Da; subgroup 7C).—This somewhat excessively drained soil developed in 12 to 42 inches of eolian loamy sands and sands that overlie glacial till. It is associated with the Maddock soils, which have developed in eolian loamy sands and sands that are deeper to till than 42 inches. The soil, however, does not occur in any set pattern with the Maddock soils. The gently undulating relief of this Dickey soil results partly from the slump and subsequent deterioration of superficial dunes. The soil occurs principally in area 32.

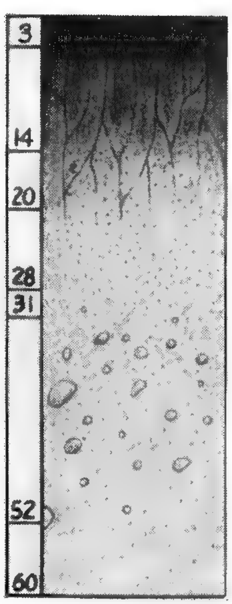

***Figure 11.*—Dickey sandy loam.**

Dickey sandy loam, undulating (4 to 8 percent slopes) (Db; subgroup 7C).—This soil is similar to Dickey sandy loam, gently undulating, except in slope. It occurs primarily in soil area 32.

Egeland series

The Egeland soils in Brookings County are well-drained Chernozems that have developed under tall grasses in eolian sandy loams, which overlie sands or glacial till, or both. They occur on nearly level and gently undulating uplands in fairly close association with the Flandreau soils and in somewhat broader association with the Maddock and Dickey soils. Egeland soils do not occur in any set pattern in the landscape or in relation to the associated soils.

The Egeland soils have an A_1 horizon of very dark grayish-brown, very friable sandy loam that grades into a B_2 horizon that is dark brown to dark yellowish brown, very friable, and weakly to moderately developed. The B_2 horizon grades to a C horizon that is olive brown and noncalcareous in the upper part and light yellowish brown and moderately calcareous in the lower part. The C horizon is more sandy in the upper part than in the lower part.

The Egeland soils of Brookings County differ from those typical of the series primarily in having a leached C horizon that underlies the B and in having no horizon of lime accumulation. They differ from the Maddock and Dickey soils in being less coarse textured, and from Flandreau soils in being more coarse textured.

Most areas of Egeland soils are used for small grains, corn, and alfalfa.

The following is a profile of Egeland sandy loam:

A_1 0 to 3 inches, very dark grayish-brown (10YR 3/2, dry) and very dark gray to very dark grayish-brown (10YR 3/1.5, moist), very friable, noncalcareous sandy loam; weak fine granular and fine platy structure; lower boundary irregular.

A_1B_1 6 to 10 inches, dark-gray to dark grayish-brown (10YR 4/1.5, dry) and very dark gray (10YR 3/1, moist), very friable, noncalcareous sandy loam; very weak coarse prismatic structure; some clay bridges between sand grains; lower boundary irregular.

B_{21} 10 to 12 inches, dark grayish-brown to dark-brown (10YR 4/2.5, dry) and very dark grayish-brown to dark-brown (10YR 3.5/3, moist), very friable, noncalcareous light sandy loam; weak to moderate coarse prismatic structure that breaks to medium prismatic and, in turn, to weak medium and fine blocky; thin, patchy clay skins on faces of peds and clay bridges between sand grains; lower boundary smooth.

B_{22} 12 to 19 inches, grayish-brown to brown (10YR 5/2.5, dry) and dark yellowish-brown (10YR 3.5/4, moist), very friable, noncalcareous loamy sand; weak to moderate coarse prismatic structure that breaks to medium prismatic and, in turn, to very weak medium and fine blocky; thin, patchy clay skins on faces of peds and clay bridges between sand grains; lower boundary smooth.

B_{23} 19 to 24 inches, brown (1Y 5/3, dry) and dark yellowish-brown (10YR 4/4, moist), very friable, noncalcareous sand; weak coarse prismatic structure; thin, very patchy clay skins on faces of structural peds and some clay bridges between sand grains; lower boundary smooth.

C_1 24 to 30 inches, light brownish-gray to pale-brown (1Y 6/2.5, dry) and dark grayish-brown to olive-brown (2.5Y 4/3, moist), very friable to loose, noncalcareous sand; massive to single-grain structure; lower boundary clear and smooth.

C_{21} 30 to 50 inches, light brownish-gray to light yellowish-brown (2.5Y 6/3, dry) and grayish-brown to light olive-brown (2.5Y 5/3, moist), loose, moderately calcareous sand; massive to single-grain structure.

C_{22} 50 to 60 inches, grayish-brown to light olive-brown (2.5Y 5/3, dry and moist), loose, moderately calcareous light sandy loam; massive to single-grain structure.

Location of profile: Sec. 21, T. 110 N., R. 48 W.; 75 yards W. and 50 yards N. of SE. corner.

Egeland sandy loam, nearly level (0 to 2 percent (Ea; subgroup 7A).—This soil has developed in more than 60 inches of eolian sandy loam materials on nearly level uplands (soil area 32). The soil is broadly associated with Egeland sandy loam, deep over loamy drift, nearly level, and with soils of the Maddock, Dickey, Flandreau, and Kranzburg series.

Egeland sandy loam, gently undulating (3 to 6 percent slopes) (Eb; subgroup 7A).—This soil has developed in more than 60 inches of eolian sandy loam. It occurs on gently undulating uplands (soil area 32) but is otherwise similar to Egeland sandy loam, nearly level.

Egeland sandy loam, deep over loamy drift, nearly level (0 to 2 percent slopes) (Ec; subgroup 7C).—This soil has developed in the uplands (soil area 32) in 36 to 60 inches of eolian sandy loam materials over loamy glacial drift. It is broadly associated with Egeland sandy loam, nearly level, and with soils of the Maddock, Dickey, Flandreau, or Kranzburg series.

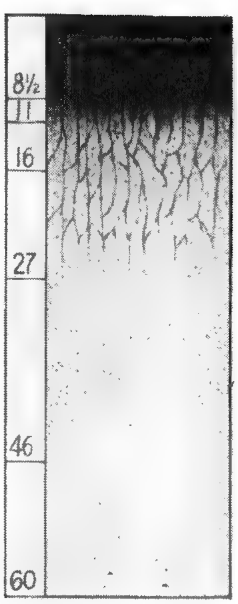

Figure 12.—Egeland sandy loam, deep over loamy drift.

The following is a profile description of Egeland sandy loam, deep over loamy drift (fig. 12):

A_{1p} 0 to 8½ inches, very dark gray (10YR 3/1.5, dry) to black (10YR 2/1, moist), very friable, noncalcareous sandy loam; cloddy to weak fine granular and single-grain structure; lower boundary clear and has tongues extending into layer below.

B_1 8½ to 11 inches, dark-gray and dark yellowish-brown (10YR 4/1 and 1Y 4/4, dry) to very dark gray and dark-brown (10YR 3/1.5 and 10YR 4/3, moist), soft, noncalcareous loam on the sandy loam boundary; weak coarse and medium prismatic structure that breaks to very weak fine blocky and, in turn, to weak fine granular; lower boundary smooth.

B_2 11 to 16 inches, dark-gray and very dark gray (10YR 4/1 and 3/1.5, dry) to dark yellowish-brown and dark-brown (1Y 4/4 and 1Y 3/2, moist), soft, noncalcareous heavy sandy loam; weak to moderate coarse prismatic structure that breaks to medium prismatic and, in turn, to weak to moderate medium and fine blocky; thin, patchy clay skins on faces of structural peds; lower boundary smooth.

B_3 16 to 27 inches, grayish-brown (2.5Y 5/3, dry) to dark grayish-brown (2.5Y 4/3, moist), soft, noncalcareous sandy loam on the loamy sand boundary; weak coarse and medium prismatic structure that breaks to weak to moderate medium and fine blocky; faces of peds have thin, patchy clay skins that decrease with depth; lower boundary clear and smooth.

C_{ca} 27 to 46 inches, light brownish-gray (2.5Y 6/3, dry) to dark grayish-brown (2.5Y 4/3, moist), loose, strongly calcareous loamy sand on the sand boundary; massive to single-grain structure; a few small lime segregations; lower boundary smooth.

C_{ca}–D 46 to 53 inches, light brownish-gray (2.5Y 6/3, dry) to grayish-brown (2.5Y 5/3, moist), loose, strongly calcareous sandy loam; massive to single-grain structure; a few small lime segregations.

Location of profile: Sec. 33, T. 109 N., R. 49 W., 0.1 mile S. of NE. corner.

Egeland sandy loam, deep over loamy drift, gently undulating (3 to 4 percent slopes) (Ed; subgroup 7C). —This soil has developed in the uplands (soil area 32) in 36 to 60 inches of eolian sandy loam materials that overlie loamy glacial drift. Except that it is gently undulating, this soil is similar to Egeland sandy loam, deep over loamy drift, nearly level.

Estelline series

The Estelline soils in Brookings County are well-drained Chernozems that have developed under tall grasses in 24 to 60 inches of calcareous, medium-textured loess; the loess overlies sand- and-gravel outwash. The soils occur on nearly level and gently sloping glacial stream terraces and outwash plains (fig. 13).

The Estelline soils have a black, granular A_1 horizon; a dark grayish-brown prismatic and blocky B_2 horizon; and a lighter colored C_{ca} horizon that overlies a D horizon of mixed outwash sands and gravels. In Brookings County only the silt loams are mapped. These soils modally have a C_{ca} horizon, but in the moderately shallow phases they sometimes have a D_{ca} horizon.

The Estelline soils are the well-drained catenal associates of the moderately well drained Athelwold soils,

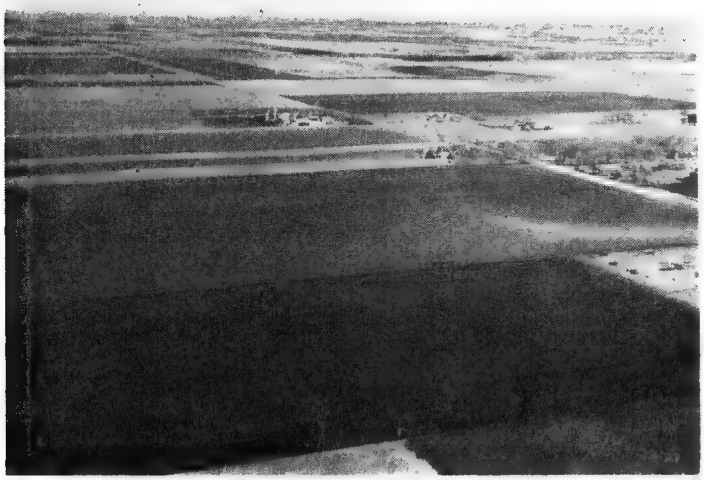

Figure 13.—**Estelline soils on Aurora terrace. Note flat landscape.**

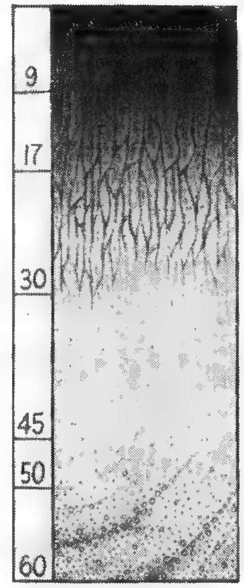

Figure 14.—**Estelline silt loam.**

which are Chernozem-Prairie intergrades, and the somewhat poorly drained Hatfield soils, which are Humic Gleys. They differ from the Fordville and Wessington soils in having developed in silty loess instead of gritty water-laid materials.

The Estelline soils are used primarily for corn, small grains, and alfalfa.

The following is a profile description of Estelline silt loam (fig. 14):

A_{1p} 0 to 9 inches, very dark gray (10YR 3.5/1, dry) to black (10YR 2/1, moist), very friable, noncalcareous silt loam; cloddy to weak fine granular structure; lower boundary clear and smooth.

B_{21} 9 to 17 inches, dark gray (10YR 4/1.5, dry) to very dark gray (10YR 3/1.5, moist), friable, noncalcareous silt loam; weak to moderate medium prismatic structure that breaks to moderate medium blocky and, in turn, to weak fine granular; lower boundary clear and smooth.

B_{22} 17 to 30 inches, grayish-brown (1Y 5/2.5, dry) to dark grayish-brown (2.5Y 4/2.5, moist), friable, noncalcareous silt loam; weak to moderate medium prismatic structure that breaks to moderate medium blocky and, in turn, to weak fine granular; thin, very patchy clay skins on peds; lower boundary clear and smooth.

C_{ca} 30 to 45 inches, light brownish-gray and white (2.5Y 6/2 and 8/0, dry) to grayish-brown and white (2.5Y 5/2.5 and 8/0, moist), friable, strongly calcareous silt loam; hard lime concretions are common; massive structure.

C–D 45 to 50 inches, light-gray (2.5Y 7/2.5, dry) to grayish-brown (2.5Y 5/2.5, moist), friable, strongly calcareous loam; contains a few hard lime concretions; massive structure.

D 50 to 60 inches, light brownish-gray (2.5Y 6/2.5, dry) to grayish-brown (2.5Y 5/2.5, moist), loose, strongly calcareous loamy sand; single-grain structure.

Location of profile: Sec. 25, T. 110 N., R. 49 W.; 100 yards S. of NW. corner.

Estelline silt loam, nearly level (0 to 2 percent slopes) (Ee; subgroup 6A).—This soil has developed in loess that is 36 to 60 inches deep. It occurs on broad stream terraces and outwash plains (soil area 20).

Estelline silt loam, nearly level, is in the same catena as the moderately well drained Athelwold soil. The soil is also broadly associated with Estelline silt loam, moderately shallow, nearly level. These two Estelline soils form the general terrace relief in which the Athelwold soil occurs. The Athelwold soil occupies the more nearly level or slightly depressed terrace flats and the slightly to moderately depressed crisscrossed channels and drainageways. The gentle slopes down to the drainageways are occupied by Estelline silt loam, gently sloping, and Estelline silt loam, moderately shallow, gently sloping.

Estelline silt loam, gently sloping (3 to 6 percent slopes) (Eg; subgroup 6A).—This soil has developed in loess that is 36 to 60 inches deep. It occurs on broad stream terraces and outwash plains (soil area 20). It is on the gentle slopes that extend from Estelline silt loam, nearly level, to the depressed channels and drainageways of the moderately well drained Athelwold soil.

Estelline silt loam, moderately shallow, nearly level (0 to 2 percent slopes) (Eh; subgroup 6C).—This soil has developed in loess that is 24 to 36 inches deep. It occurs on broad stream terraces and outwash plains (soil area 20). The soil occurs in broad association with Estelline silt loam, nearly level, but differs from it in being more shallow to the outwash sands and gravels. Because the soil is shallow, the calcium carbonate accumulations may occur as a C_{ca} or a D_{ca} horizon, or both, but in Estelline silt loam, nearly level, the C_{ca} is the horizon of lime accumulation.

Estelline silt loam, moderately shallow, gently sloping (3 to 6 percent slopes) (Ek; subgroup 6C).—This well-drained soil has developed in loess that is 24 to 36 inches deep. It occurs on broad stream terraces and outwash plains (soil area 20). In profile it is similar to Estelline silt loam, moderately shallow, nearly level. It occurs in positions similar to those of Estelline silt loam, gently sloping.

Flandreau series

The Flandreau soils in Brookings County are well-drained Chernozems that have developed under tall grasses in loess that overlies eolian sand. These soils occur on nearly level undulating, gently sloping, and sloping uplands in fairly close association with the Kranzburg and Egeland soils, and in somewhat broader association with the Maddock and Dickey soils. They do not occur in any set pattern in the landscape or in relation to the associated soils.

The Flandreau soils have an A_1 horizon of black to very dark brown, very friable loam or silt loam that grades irregularly into a B_2 horizon of dark grayish-brown to yellowish-brown, friable, moderately developed prismatic and blocky loam or silt loam. The B_2 horizon overlies a D_{ca} horizon of light olive-brown, very friable loamy sand. The D_{ca} horizon is underlain by a D horizon of loose loamy sand. Flandreau loams and silt loams are mapped in Brookings County.

The Flandreau soils differ from the Kranzburg soils in that their substratum is a sand rather than loam-clay loam glacial till. They differ from the Egeland, Maddock, and Dickey soils in that their profile is less coarse textured.

Most areas of this soil are used for small grains, corn, and alfalfa.

The following is a profile description of Flandreau loam (fig. 15):

A_1 0 to 7 inches, very dark grayish-brown to dark grayish-brown (10YR 3.5/2, dry) and black to very dark brown (10YR 2/1.5, moist), very friable, noncalcareous loam; weak fine granular and fine platy structure; lower boundary irregular.

A_1B_1 7 to 10 inches, dark grayish-brown (10YR 4/2, dry) and very dark grayish-brown (10YR 3/2, moist), very friable, noncalcareous, heavy loam; weak fine and medium blocky structure; lower boundary smooth.

B_{21} 10 to 16 inches, dark grayish-brown (1Y 4/2, dry) and very dark grayish-brown to dark grayish-brown (10YR 3.5/2, moist), friable, noncalcareous heavy loam; weak to moderate prismatic structure that breaks to weak to moderate fine and medium blocky; thin patchy clay skins on faces of peds, and moderate continuous clay skins in root channels; lower boundary smooth.

B_{22} 16 to 23 inches, light olive-brown (1Y 5/4, dry), to olive-brown (1Y 4/4, moist), friable, noncalcareous heavy loam; weak to moderate coarse and medium prismatic structure that breaks to weak medium and fine blocky; thin patchy clay skins on faces of peds, and moderate continuous clay skins in root channels; lower boundary clear and smooth.

D_{ca} 23 to 33 inches, light brownish-gray to light yellowish-brown (2.5Y 6/3, dry) and olive-brown to light olive-brown (2.5Y 4.5/4, moist), very friable, moderately calcareous loamy sand; very weak coarse prismatic structure; a few medium and small hard concretions of lime.

D 33 to 60 inches, light brownish-gray to light yellowish-brown (2.5Y 6/3, dry) and light olive-brown (2.5Y 5/4, moist), very friable to loose, moderately calcareous loamy sand; massive to single-grain structure.

Location of profile: Sec. 27, T. 110 N., R 49 W.; 0.1 mile E. and 50 feet S. of the N. ¼corner.

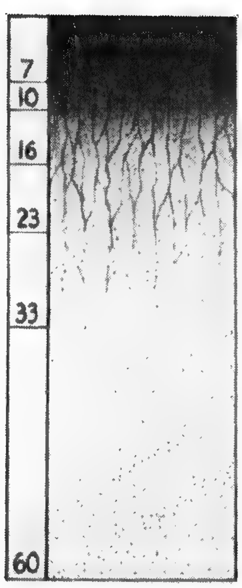

Figure 15.—**Flandreau loam.**

Flandreau silt loam, nearly level (0 to 2 percent slopes) (Fg; subgroup 2A).—This soil has developed in moderately deep, calcareous, medium-textured loess that overlies eolian sandy materials. It occurs in the nearly level areas of the uplands (soil area 32). The soil is broadly associated with Flandreau silt loam. deep, nearly level; Flandreau loam, deep, nearly level; and Flandreau loam, deep over till, nearly level. It is also associated with the Maddock, Dickey, Egeland, and Kranzburg soils. It does not occur in any set pattern with the associated soils.

Flandreau silt loam, gently sloping (3 to 4 percent slopes) (Fh; subgroup 2B).—This soil has developed in moderately deep, calcareous, medium-textured loess that overlies eolian sandy materials. The soil is broadly associated with Flandreau loam, deep, gently undulating; and Flandreau loam, deep over till, gently sloping. It is also associated with the Maddock, Dickey, Egeland, and Kranzburg soils. It does not occur in any set pattern with the associated soils. In profile this soil is similar to Flandreau silt loam, nearly level, but it occurs in soil area 32 on gentle slopes rather than level areas.

Flandreau loam, deep, nearly level (0 to 2 percent slopes) (Fa; subgroup 2A).—This soil has developed in deep, calcareous, medium-textured loess that overlies eolian sandy materials. It occurs in nearly level uplands (soil area 32). The soil is broadly associated with Flandreau silt loam, nearly level; Flandreau silt loam, deep, nearly level; and Flandreau loam, deep over till, nearly level. It is also associated with Maddock, Dickey, Egeland, and Kranzburg soils. The soil does not occur in any set pattern in relation to associated soils. It differs from Flandreau silt loam, nearly level, primarily in being deeper to the underlying sandy materials.

Flandreau loam, deep, gently undulating (3 to 4 percent slopes) (Fb; subgroup 2B).—This soil has developed in deep, calcareous, medium-textured loess that overlies eolian sandy materials. It occurs on gently undulating uplands (soil area 32). It is broadly associated with Flandreau silt loam, gently sloping, and

with Flandreau loam, deep over till, gently sloping. It is also associated with soils of the Maddock, Dickey, Egeland, and Kranzburg series. It does not occur in any set pattern with associated soils. From the profile of Flandreau loam described, it differs primarily in being deeper to the underlying sandy materials.

Flandreau silt loam, deep, nearly level (0 to 2 percent slopes) (Fk; subgroup 2A).—This soil has developed in deep, calcareous, medium-textured loess that overlies eolian sandy materials. It occurs on nearly level, eolian upland positions in soil area 32. It is broadly associated with Flandreau silt loam, nearly level; Flandreau loam, deep, nearly level; and Flandreau loam, deep over till, nearly level. It is also associated with the Maddock, Dickey, Egeland, and Kranzburg soils. It does not occur in a regular pattern with the associated soils. The soil differs from the profile of Flandreau loam described primarily in being deeper to the underlying sandy materials.

Flandreau loam, deep over till, nearly level (0 to 2 percent slopes) (Fc; subgroup 2A).—This soil has developed in deep, calcareous, medium-textured loess. The loess overlies eolian sandy materials, which, in turn, overlie a substratum of glacial till. The loess occurs on nearly level, eolian upland positions in soil area 32. This soil is associated with the same soils and has the same relation with these soils as Flandreau silt loam, nearly level. It differs from the profile of Flandreau loam previously described mainly in being deeper to the underlying sandy materials and in having an underlying till substratum.

The following is a profile description of Flandreau loam, deep over till:

A_{1p} 0 to 4 inches, very dark gray (10YR 3.5/1, dry) to black (10YR 2/1, moist), friable, noncalcareous loam; cloddy to weak fine crumb structure; lower boundary clear and smooth.

A_{11} 4 to 9 inches, very dark gray (10YR 3.5/1, dry) to black (10YR 2/1, moist), friable, noncalcareous silt loam; very weak coarse prismatic structure that breaks to very weak coarse, medium, and fine blocky and, in turn, to moderate fine crumb and granular; lower boundary smooth.

B_1 9 to 14 inches, very dark gray (10YR 3/1.5, dry) to black (10YR 2/1.5, moist), slightly hard, noncalcareous loam; weak coarse prismatic structure that breaks to weak coarse and medium blocky and, in turn, to weak fine granular; lower boundary smooth.

B_{21} 14 to 22 inches, dark gray (10YR 4/1.5, dry) to very dark gray (3/1.5, moist), slightly hard, noncalcareous silt loam; weak to moderate coarse prismatic structure that breaks to medium prismatic and, in turn, to weak to moderate coarse, medium, and fine blocky, and finally to weak to moderate very fine blocky; thin, very patchy clay skins on structural peds; lower boundary smooth.

B_{22} 22 to 27 inches, grayish-brown (2.5Y 5/2, dry) to very dark grayish-brown (2.5Y 3/2, moist), slightly hard, noncalcareous silt loam; weak to moderate coarse prismatic structure that breaks to weak to moderate coarse, medium, and fine blocky and, in turn, to weak to moderate very fine blocky; thin, very patchy clay skins on structural peds; lower boundary smooth.

B_{23} 27 to 38 inches, grayish-brown (2.5Y 5/3, dry) to dark grayish-brown (2.5Y 4/3, moist), slightly hard, noncalcareous loam; weak to moderate coarse prismatic structure that breaks to weak to moderate coarse blocky and, in turn, to weak to moderate fine granular; thick, patchy clay skins on peds; lower boundary smooth.

D_1 38 to 54 inches, light brownish-gray (2.5Y 6/3, dry) to grayish-brown (2.5Y 5/3, moist), loose, slightly calcareous loamy sand; single-grain structure; lower boundary clear and smooth.

D_{2ca} 54 to 60 inches, light brownish-gray, light olive-brown, and white (2.5Y 6/3, 5/5, and 8/0, dry) to grayish-brown, olive-brown, and white (2.5Y 5/3, 4/4, and 8/0, moist) clay loam glacial till; firm to very firm; calcareous; massive structure; very large soft segregations of lime are common.

Location of profile: Sec. 36, T. 109 N., R. 49 W., 0.2 mile S. of NW. corner.

Flandreau loam, deep over till, gently sloping (3 to 4 percent slopes) (Fd; subgroup 2B).—This soil has developed in deep, calcareous, medium-textured loess. The loess overlies eolian sandy materials, which are underlain by a substratum of glacial till. The soil occurs on gently sloping uplands in soil area 32. It is broadly associated with Flandreau silt loam, gently sloping, and with Flandreau loam, deep, gently undulating. It is also associated with soils of Maddock, Dickey, Egeland, and Kranzburg series. The soil differs from the profile described for Flandreau loam primarily in being deeper to the underlying sandy materials and in having an underlying till substratum.

Flandreau loam, deep over till, sloping (3 to 4 percent slopes) (Fe; subgroup 3A).—This soil has developed in deep, calcareous, medium-textured loess. The loess overlies eolian sandy materials, which are underlain by a substratum of glacial till. The soil is similar in profile to Flandreau loam, deep over till, nearly level, and Flandreau loam, deep over till, gently sloping. It differs from these soils, however, in that it occurs on sloping positions in soil area 32.

Fordville series

The Fordville soils in Brookings County are well-drained Chernozems. They have developed under tall grasses in moderately deep, calcareous glacial alluvium, which overlies stratified mixed sand and gravel or gravelly outwash. The soils occur on broad stream terraces and outwash plains.

The Fordville soils have a black, friable A_1 horizon. Their B_2 horizon is dark grayish brown to very dark grayish brown, friable, and of prismatic and blocky structure. This horizon shows weak clay skin development and is underlain by a C, D, C_{ca}, or D_{ca} horizon. In Brookings County the C, D, C_{ca}, and D_{ca} horizons do not occur regularly in the profile, and their positions relative to each other vary. This variability appears to be somewhat affected by differences in texture, age, and stage of soil formation caused by microrelief. Fordville soils in the county tend to have profiles with leached C or D horizons over the appropriate C_{ca} or D_{ca} horizon. Fordville loams and sandy loams are mapped in Brookings County.

The Fordville soils are the well-drained members of the catena that also includes the somewhat excessively drained Renshaw soils and the excessively drained Sioux soils. The Renshaw soils are Chernozems, and the Sioux are Regosols. Fordville soils differ from

the Wessington soils, their drier region analogs, and from the Spottswood soils, which also occur in somewhat drier regions, in being well drained rather than moderately well drained. They are broadly associated with soils of the Estelline catena but differ in that they have developed in gritty water-deposited materials instead of silty loess.

Most areas of Fordville soils are used for small grains and corn.

Following is a profile description of Fordville sandy loam (fig. 16):

A_{1p} 0 to 6 inches, very dark gray (10YR 3/1.5, dry) to black (10YR 2/1.5, moist), very friable, noncalcareous sandy loam; weak fine crumb structure; lower boundary clear and smooth.

B_{21} 6 to 11 inches, dark grayish-brown (1Y 4/2, dry) to very dark grayish-brown (10YR 3/2, moist), very friable, noncalcareous sandy loam; moderate medium and coarse prismatic structure that breaks to weak medium and coarse blocky; thin, patchy clay skins on peds; lower boundary smooth.

B_{22} 11 to 19 inches, dark grayish-brown (1Y 4/2.5, dry) to very dark grayish-brown (1Y 3/2.5, moist), friable, noncalcareous sandy loam on the sandy clay loam boundary; moderate medium and coarse prismatic structure that breaks to weak medium and coarse blocky; thin, continuous clay skins on peds; lower boundary smooth.

C 19 to 28½ inches, grayish-brown (2.5Y 5/2.5, dry) to dark grayish-brown (2.5Y 4/2.5, moist), friable, noncalcareous sandy loam; weak coarse prismatic to massive structure; lower boundary clear and smooth.

D_1 28½ to 31 inches, grayish-brown (2.5Y 5/2.5, dry) to very dark grayish-brown (2.5Y 3.5/2, moist), loose, noncalcareous loamy sand; single-grain structure; lower boundary clear but irregular.

D_{ca} 31 to 55 inches, multicolored sand; basic color light brownish gray (2.5Y 6/2); loose; strongly calcareous; single-grain structure; lime crusts on the pebbles.

D_2 55 to 60 inches, multicolored sand; basic color light brownish gray (2.5Y 6/2); loose; slightly calcareous; single-grain structure.

Location of profile: Sec. 1, T. 112 N., R. 52 W., 0.3 mile W. and 100 feet S. of NE. corner.

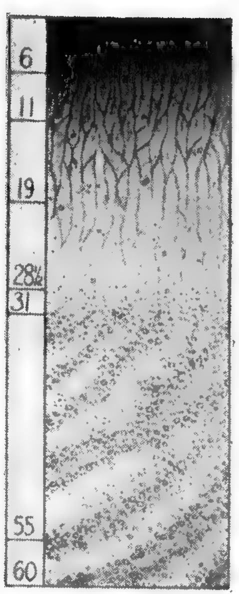

Figure 16.—**Fordville sandy loam.**

Fordville loam, nearly level (0 to 2 percent slopes) (Fm; subgroup 6C).—This soil has developed in medium-textured glacial alluvium and occurs in soil area 21. The soil, together with Fordville loam, thick solum, nearly level; Fordville loam, deep, nearly level; and Fordville sandy loam, nearly level, occurs on the nearly level positions on the terraces or outwash plains. It is broadly associated with Fordville loam, gently undulating, and Fordville sandy loam, gently undulating, which occur on gently undulating terrace positions and on the slopes that extend down to the alluvial drains that dissect the terraces.

Fordville loam, gently undulating (3 to 6 percent slopes) (Fn; subgroup 6C).—This soil has developed in medium-textured glacial alluvium and is in soil area 21. It is similar in profile to Fordville loam, nearly level, but differs in that it occurs on gently undulating terraces and on the slopes that extend down to the alluvial drains. These alluvial drains dissect the nearly level terraces on which Fordville loam, nearly level, occurs.

Fordville loam, thick solum, nearly level (0 to 2 percent slopes) (Fo; subgroup 6C).—This soil has developed in medium-textured glacial alluvium and occurs in soil area 21. It differs from the other soils of the Fordville series in thickness of solum and in position. Its solum is thicker than that of these soils, and it occurs in nearly level, slightly concave positions where the amounts of colluvium and alluvium vary.

Fordville loam, deep, nearly level (0 to 2 percent slopes) (Fp; subgroup 6A).—This soil has developed in medium-textured glacial alluvium and occurs in soil area 21. The soil is associated with the other soils of the Fordville series, but it differs from them in that it is deeper to the underlying gravelly substratum. This characteristic does not appear to be related to the relief.

Fordville sandy loam, nearly level (0 to 2 percent slopes) (Fr; subgroup 7A).—This well-drained soil has developed in moderately coarse textured glacial alluvium and is in soil area 21. Like the other nearly level Fordville soils, it occurs on the nearly level positions on terraces and outwash plains. It is broadly associated with Fordville loam, gently undulating, and Fordville sandy loam, gently undulating, which occur on gently undulating terrace positions and on the slopes extending to the alluvial drains that dissect the terraces.

Fordville sandy loam, gently undulating (3 to 6 percent slopes) (Fs; subgroup 7A).—This well-drained soil has developed in moderately coarse textured glacial alluvium and occurs in soil area 21. In profile it is similar to Fordville sandy loam, nearly level. It occurs on gently undulating terrace positions and on the slopes that extend to the alluvial drains that dissect the nearly level terraces on which Fordville sandy loam, nearly level, occurs.

Hecla series

The Hecla soils in Brookings County are well-drained Regosol-Chernozem intergrades. They have developed

under tall and mid grass associations in deep, coherent, wind-reworked terrace alluvium that is weakly stratified and of sandy loam texture. This alluvium is more sandy, more strongly stratified, and less coherent with depth. Hecla soils occur on low stream terraces, high bottoms, and coalescent fans. These positions are between the flood plain and the upgrade of the upland and are somewhat colluvial and alluvial.

Hecla soils have an A horizon of fairly thick, very dark gray to black sandy loam that grades into a weakly developed B horizon of very dark brown sandy loam. The B horizon grades downward through the sandier, less coherent, more strongly stratified C or D horizon, or both.

The Hecla soils of Brookings County differ from soils of the Hecla series as mapped in other counties in being (1) well drained instead of moderately well drained; (2) Regosol-Chernozem intergrades with a B horizon instead of Regosols with A-C profiles; (3) less coarse textured; (4) without gley characteristics; and (5) modally noncalcareous in the 5-foot profile.

In Brookings County, Hecla sandy loams and loams are mapped. In these soils the B horizon varies in strength of development. It ranges in color and structure from very weak to moderate and is the main intergrading characteristic in the classification of Hecla soils. In this area Hecla soils are normally not calcareous, but slightly calcareous material does occur below 48 inches in some inextensive mapping inclusions. In some areas, less sandy D horizons underlie the loamy sand substratum in an unpredictable pattern, but this condition is not considered modal.

The Hecla soils of Brookings County are the terrace analogs of the Maddock soils, which are Regosol-Chernozem intergrades of the upland. Like the Hecla soils, the Maddock soils have developed in fractionated eolian sands, but they have stronger horizons of lime accumulation. The upland Flandreau soils have more silty solums than the Hecla and Maddock soils.

Hecla soils are used primarily for corn and small grains, but some areas are in grass, which is used for pasture or hay. Following is a profile description of Hecla sandy loam (fig. 17):

A_{1p}	0 to 7 inches, very dark gray (10YR 3/1, dry) to black (10YR 2/1, moist), very friable, noncalcareous sandy loam; weak fine crumb structure; lower boundary clear and smooth.
A_1	7 to 12 inches, very dark gray (10YR 3/1, dry) to black (10YR 2/1, moist), very friable, noncalcareous sandy loam; weak fine crumb structure; lower boundary smooth.
B_2	12 to 17 inches, dark-gray to dark grayish-brown (10YR 4/1.5, dry) and black to very dark brown (10YR 2/1.5, moist), very friable, noncalcareous loamy sand, on the sandy loam boundary; weak coarse prismatic structure that breaks to weak coarse blocky; lower boundary smooth.
C_1	17 to 42 inches, dark grayish-brown (10YR 4/2, dry) to very dark grayish-brown (10YR 3/2, moist), very friable to loose, noncalcareous loamy sand; massive to single-grain structure.
C_1–D_1	42 to 48 inches, gray to grayish-brown (10YR 5/1.5, dry) and very dark grayish-brown to dark grayish-brown (10YR 3.5/2, moist), friable, noncalcareous loamy sand; massive to single-grain structure.
D_1	48 to 54 inches, dark-gray to dark grayish-brown (10YR 4/1.5, dry) and dark grayish-brown (2.5Y 3/2, moist), friable to firm, noncalcareous sandy loam; massive structure.

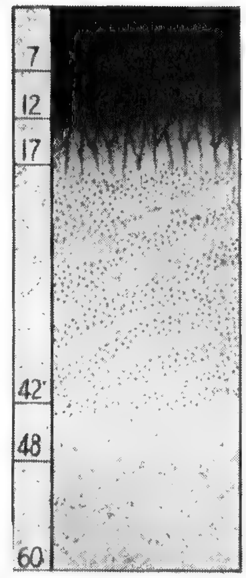

Figure 17.—Hecla sandy loam.

Location of profile: Sec. 32, T. 112 N., R. 50 W.; 270 feet E. and 275 feet S. of the N. 1/4 corner.

Hecla sandy loam, nearly level (0 to 2 percent slopes) (Hb; subgroup 7B).—This soil occurs in broad association with Hecla loam, undulating (soil area 22). It has a similar profile but differs in slope and texture of the surface soil.

Hecla loam, undulating (1 to 5 percent slopes) (Ha; subgroup 7A).—This soil is similar to the associated Hecla sandy loam, nearly level, in profile characteristics but differs in slope and texture of the surface soil. It occurs in soil area 22.

Hidewood series

The Hidewood soil in Brookings County is a somewhat poorly drained Chernozem-Humic Gley intergrade. It has developed under tall grasses in moderately deep, calcareous silty clay loam loess or local alluvium from the loess, or both. These materials mantle glacial till.

The Hidewood soil has an A_1 horizon of thick, black, friable silty clay loam. Its B_{2g} horizon is mottled, grayish-brown and olive-brown, slightly gleyed, friable to firm silty clay loam of weak to moderate prismatic and blocky structure. The B_{3g} horizon is mottled, light-gray and light olive-brown, friable to firm silty clay loam of weak to moderate prismatic and blocky structure. The B_{3g} horizon is underlain respectively by C_g, D_g (glacial till), and D_{ca} horizons.

The Hidewood soil differs from the Leota soils in having developed in loess instead of glacial till. They differ in drainage from the associated Brookings and Kranzburg soils.

Many areas of this soil are used for small grains, corn, and alfalfa, and many areas are in pasture.

The following is a profile description of Hidewood silty clay loam (fig. 18):

A_{11} 0 to 5 inches, gray to grayish-brown (2.5Y 4/1, dry) and black (1Y 2/1, moist), very friable, noncalcareous silty clay loam; weak fine granular structure; lower boundary clear and smooth.

A_{12} 5 to 11 inches, gray to grayish-brown (2.5Y 4/1, dry) and black (1Y 2/1, moist), friable, noncalcareous silty clay loam; weak very coarse prismatic structure that breaks to weak to moderate fine platy; lower boundary clear and smooth.

B_1 11 to 18 inches, dark-gray to dark grayish-brown (2.5Y 4/1.5, dry) and very dark gray to very dark grayish-brown (2.5Y 3/1.5, moist), friable to firm, noncalcareous silty clay loam; weak to moderate coarse and medium prismatic structure that breaks to moderate very fine subangular blocky; lower boundary smooth.

B_{2g} 18 to 26 inches, grayish-brown, mottled with light olive brown (2.5Y 5/2 and 5/4, dry) and dark grayish-brown and olive-brown (2.5Y 4/2 and 4/4, moist), friable to firm, noncalcareous, heavy silty clay loam; moderate medium prismatic structure that breaks to moderate very fine subangular blocky; thin, patchy clay skins on faces of structural peds; lower boundary smooth.

B_{3g} 26 to 32 inches, gray to light-gray mottled with light olive brown (5Y 6/1 and 2.5Y 5/4, dry) and dark-gray and olive (5Y 4/1 and 5/3, moist), friable to firm, noncalcareous silty clay loam; weak and weak to moderate medium prismatic structure that breaks to weak very fine subangular blocky; lower boundary smooth.

C_g 32 to 38 inches, mottled light-gray and light olive-brown (5Y 7/1, 6/2, and 2.5Y 5/4, dry), and gray, olive-gray, and light olive-brown (5Y 5/1, 5/2, and 2.5Y 5/4, moist) silty clay loam; friable to firm; noncalcareous; massive structure.

D_g 38 to 56 inches, light brownish-gray mottled with light olive brown (2.5Y 6/2 and 5/6, dry), and grayish-brown to light olive-brown and olive-brown (2.5Y 5/3 and 4/4, moist) clay loam glacial till; firm; noncalcareous; massive structure.

D_{ca} 56 to 65 inches, mottled olive-yellow, light brownish-gray, and white (2.5Y 6/6, 6/2, and 8/1, dry) and olive-yellow, grayish-brown, and white (1Y 6/6, 2.5Y 5/2, and 8/1, moist) clay loam glacial till; large, soft segregations of lime are common; firm; moderately calcareous; massive to weak fine horizontal blocky structure.

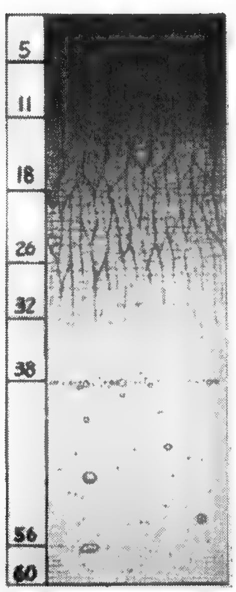

Figure 18.—Hidewood silty clay loam.

Location of profile: Sec. 16, T. 112 N., R. 48 W.; 0.2 mile N. and 65 yards W. of SE. corner.

Hidewood silty clay loam, nearly level (0 to 2 percent slopes) (Hc; subgroup 8B).—This somewhat poorly drained soil occurs on slightly depressed upland flats in catenal association with the well-drained Kranzburg soils on nearly level and gentle convex slopes, and with the moderately well drained Brookings soils on nearly level upland flats and in upland drainageways. It also occurs in association with the Brookings soils in the more poorly drained parts of the depressed upland stems of the dendritic drainage pattern. This Hidewood soil occurs in soil area 30.

Kranzburg series

The Kranzburg soils in Brookings County are well-drained Chernozems that have developed under tall grasses in moderately deep, calcareous, medium-textured loess. The loess overlies friable to firm loam or clay loam glacial till, or both (fig. 19).

Figure 19.—Kranzburg soils on nearly level areas to right; Vienna soils on sloping land to left. Note integrated drainage.

The Kranzburg soils occur in catenal association with the moderately well drained Brookings soils and the somewhat poorly drained Hidewood soil. In this association they comprise the nearly level, convex, gently sloping, and sloping matrix that contains the upland flats occupied by the Brookings soils, and the shallow to moderately deep dendritic drains occupied by the Brookings and Hidewood soils.

The proportion of matrix positions to the associated positions varies somewhat according to the surface conformation of the underlying till. In Brookings County this proportion can be correlated with drift sheets, since the Tazewell ground moraine is more rolling than the Iowan.

There are two kinds of Kranzburg soils in Brookings County. The differences between the two are illustrated in the following profile descriptions and in table 7.

The first—profile A—is a description of Kranzburg silt loam (fig. 20) that is located on the loess-mantled

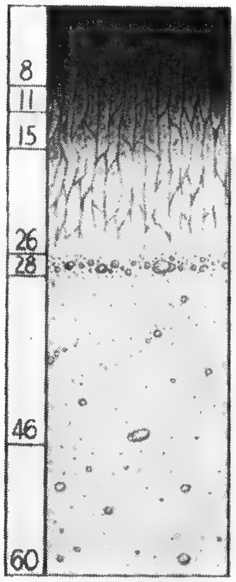

***Figure 20.*—Kranzburg silt loam (profile A).**

Iowan drift east of the Big Sioux River. This profile is considered modal Kranzburg for the county.

A_{1p} 0 to 8 inches, very dark gray (1Y 3.5/1, dry) to very dark brown (1Y 2/2, moist), very friable, noncalcareous silt loam; weak fine crumb structure; lower boundary clear but irregular.

B_{21} 8 to 11 inches, dark grayish-brown (1Y 4/2, dry) to very dark grayish-brown (10YR 3/2, moist), friable, noncalcareous silty clay loam; weak medium prismatic structure that breaks to weak fine granular; lower boundary smooth.

B_{22} 11 to 15 inches, grayish-brown (1Y 5/2, dry) to very dark grayish-brown (10YR 3.5/2, moist), friable, noncalcareous silty clay loam; moderate medium prismatic structure that breaks to moderate medium blocky and, in turn, to moderate fine and medium granular; thin continuous clay skins on structural peds; lower boundary smooth.

B_{23} 15 to 26 inches, grayish-brown (1Y 5/2.5, dry) to dark grayish-brown (2.5Y 4/2.5, moist), friable, noncalcareous silty clay loam; weak to moderate medium prismatic structure that breaks to moderate medium blocky and, in turn, to moderate fine and medium granular; thin continuous clay skins on peds; lower boundary smooth.

CD_{ca} 26 to 28 inches, light-gray (2.5Y 7/2.5, dry) to grayish-brown (2.5Y 5/2.5, moist), friable, strongly calcareous loam and cobbly lag materials with many lime segregations; weak medium prismatic structure that breaks to weak fine granular; lower boundary irregular.

D_{ca} 28 to 46 inches, light-gray (2.5Y 7/2.5, dry) to grayish-brown (2.5Y 5/2.5, moist), friable, strongly calcareous loam glacial till with many lime segregations; massive structure; lower boundary irregular.

D 46 to 60 inches, light-gray (2.5Y 7/2.5, dry) to grayish-brown (2.5Y 5/2.5, moist), friable, strongly calcareous clay loam glacial till with a few lime segregations; massive structure.

Location of profile: Sec. 24, T. 111 N., R. 50 W.; 400 feet W. of the N. ¼corner.

The second—profile B—is a description of Kranzburg silt loam (fig. 20) that is located on loess-mantled Iowan drift west of the Big Sioux River in Brookings County.

A_{1p} 0 to 5½ inches, very dark gray (10YR 3/1.5, dry) to black (10YR 2/1, moist), very friable, noncalcareous silt loam; weak fine crumb structure; lower boundary clear and smooth.

B_1 5½ to 9½ inches, dark gray (10YR 4/1.5, dry) to very dark gray (10YR 3/1.5, moist), very friable, noncalcareous silt loam; weak medium blocky structure; lower boundary smooth.

B_{21} 9½ to 14 inches, dark grayish-brown (1Y 4/2, dry) to very dark gray (10YR 3/1.5, moist), friable, noncalcareous silt loam; moderate medium and coarse prismatic structure that breaks to weak medium blocky; thin continuous clay skins on peds; lower boundary smooth.

B_{22} 14 to 30 inches, grayish-brown (2.5Y 5/2.5, dry) to dark grayish-brown (2.5Y 4/2.5, moist), friable, noncalcareous silt loam; moderate medium and coarse prismatic structure that breaks to moderate medium blocky; thin continuous clay skins on peds; lower boundary abrupt and wavy.

D_{ca} 30 to 46 inches, light brownish-gray and white (2.5Y 6/2.5 and 8/0, dry) to dark grayish-brown and white (2.5Y 4/2.5 and 8/0, moist) loam; medium, soft segregations of lime are common; friable; strongly calcareous; massive structure.

D 46 to 60 inches, light-gray and white (2.5Y 7/2.5 and 8/0, dry), to dark grayish-brown and white (2.5Y 5/2.5 and 8/0, moist) clay loam; a few small soft segregations of lime; friable to firm; moderately calcareous; massive structure.

Location of profile: Sec. 3, T. 112 N., R. 51 W.; 0.15 mile E. and 75 feet N. of the S. ¼corner.

The modal Kranzburg soils of Brookings County, represented by profile A, differ from soils of the Kranzburg series as mapped in other counties. They have a thinner, darker A_1 horizon and a B_2 horizon that is more strongly developed in structure and texture but more weakly developed in color (lower hue, value, and chroma). They also have a D_{ca} horizon that is free of hard concretions of lime. The Kranzburg soils of Brookings County represented by soil profile B differ from the Kranzburg series as mapped in other counties in the same characteristics and to the same degree as soils represented by profile A, except for the textural development of the B horizon. This development, about equal to that of the series as mapped in other counties, is weaker than the development of the B horizon of profile A.

Almost all of the acreage of Kranzburg soils in Brookings County is used for corn, small grains, and alfalfa.

Kranzburg silt loam, nearly level (0 to 2 percent slopes) (Kc; subgroup 2A).—This soil is a member of the same catena as the moderately well drained Brookings soils and the somewhat poorly drained Hidewood soil. It occurs on nearly level convex slopes. Kranzburg silt loam, nearly level, in its association with other Kranzburg soils and with the Moody soils, occurs on nearly level positions similar to those of Moody silt loam, nearly level, and Kranzburg loam, nearly level. It differs from the Moody soil, however, in that it is less deep to the till substratum. It differs from Kranzburg loam, nearly level, in that its surface soil is silt loam instead of loam. This unit occurs in soil area 30.

Kranzburg silt loam, gently sloping (3 to 4 percent slopes) (Kd; subgroup 2B).—This soil has the same

catenal relations to the moderately well drained Brookings soils and the somewhat poorly drained Hidewood soil as Kranzburg silt loam, nearly level. In profile it is similar to Kranzburg silt loam, nearly level. It extends from the nearly level soil to the drainageways in which the less well drained catenal associates occur. The soil occurs in positions similar to those of Moody silt loam, nearly level, and Kranzburg loam, gently sloping. It differs from the Moody soil, however, in that it is less deep to the till substratum. It differs from the Kranzburg soil in that its surface soil is silt loam instead of loam. This unit occurs in soil area 30.

Kranzburg silt loam, sloping (5 to 8 percent slopes) (Ke; subgroup 3A).—The soil is similar to Kranzburg silt loam, gently sloping, in catenal relations, profile, and position, and differs from it only in occurring on somewhat more sloping positions. This unit occurs in soil area 30.

Kranzburg loam, nearly level (0 to 2 percent slopes) (Ka; subgroup 2A).—Except for the texture of the surface horizon, this soil is similar to Kranzburg silt loam, nearly level. It occurs in soil area 30.

Kranzburg loam, gently sloping (3 to 4 percent slopes) (Kb; subgroup 2B).—Except for the texture of the surface horizon, this soil is similar to Kranzburg silt loam, gently sloping. It occurs in soil area 30.

Lamoure series

The Lamoure soil in Brookings County is a somewhat poorly drained Chernozem-Humic Gley intergrade that has developed under tall grasses in 42 inches or more of medium-textured alluvium, which is underlain by mixed sand and gravel. It occurs on level and nearly level broad bottom lands and in shallow, narrow, dendritic drains that extend far back into the uplands (fig. 21).

The Lamoure soils have an A_1 horizon of black, friable, strongly calcareous silt loam or silty clay loam. The A_1 horizon grades into a B_{2g} horizon of black to very dark gray, moderately to strongly calcareous silty clay loam that is of weak to moderate prismatic and blocky structure. The B_{2g} horizon overlies a very dark gray to gray, weakly calcareous C_g horizon that grades into a D_g horizon of mixed sand and gravel. Lamoure silty clay loam, nearly level, is the only Lamoure soil mapped in Brookings County.

This Lamoure soil is in fairly close association with the Solomon, Volga, and Rauville soils.

Many areas of Lamoure silty clay loam, nearly level, are used for corn and small grains, but many areas are in grass and used for pasture or hay. The following is a profile description of Lamoure silty clay loam (fig. 22):

- A_{10} 0 to 1 inch, very dark gray (10YR 3/1, dry) to black (1Y 2/0.5, moist), friable, strongly calcareous silty clay loam on the silt loam boundary; weak fine granular structure.
- A_{11} 1 to 7 inches, very dark gray (10YR 3/1, dry) to black (1Y 2/0.5, moist), strongly calcareous silt loam; lime segregations are common; strong fine granular structure.
- B_{2g1} 7 to 16 inches, dark-gray (2.5Y 4/1, dry) to black (1Y 2/0.5, moist), weakly calcareous silt loam with a few segregations of lime; weak coarse prismatic structure that breaks to strong medium blocky.
- B_{2g2} 16 to 33 inches, dark-gray (4.5/0, dry) to very dark gray (3.5/0, moist), moderately calcareous silty clay loam; moderate medium blocky structure.
- C 33 to 48 inches, dark gray (5Y 4.5/1, dry) to very dark gray (2.5Y 3/1, moist), weakly calcareous silty clay loam; massive structure.
- C_g 48 to 60 inches, gray (5Y 6/1, dry) to gray (5Y 5/1, moist), noncalcareous silt loam that is more sandy with increased depth; massive structure.

Location of profile: Sec. 21, T. 110 N., R. 49 W.; 0.35 mile E. of SW. corner, 75 feet N. of fence and 50 feet W. of creek break.

Lamoure silty clay loam, nearly level (0 to 2 percent slopes) (La; subgroup 8B).—This soil is in soil area 10. It occurs on somewhat higher and less concave alluvial

Figure 21.—Lamoure soil; Deer Creek bottom. Note white calcareous pattern.

Figure 22.—Lamoure silty clay loam.

positions than the associated poorly drained finer textured Solomon clay, nearly level, and is somewhat more suitable for cultivation. The associated Volga soils differ from this soil primarily in being less than 42 inches deep to the nonconforming substratum. The associated Rauville soils differ in being poorly drained Humic Gleys.

Leota series

The Leota soil in Brookings County is a somewhat poorly drained Chernozem-Humic Gley intergrade that has developed under tall grass associations in calcareous, friable to firm, loam and clay loam glacial till, or local alluvium from these materials, or both. It occurs on slightly depressed upland flats and in the lower parts of the depressed stems of the dendritic drainage pattern that occurs in the Iowan and Tazewell drifts (fig. 23).

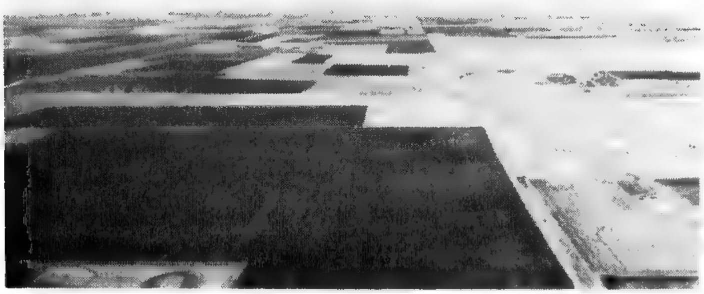

***Figure 23.*—Leota soil in drainage flat to right; Vienna soils on slopes; Lismore soils in upland drainageways.**

The A_1 horizon of Leota soils is thick, black, friable silty clay loam. The B_2 horizon is very dark grayish-brown, indistinctly mottled, friable to firm clay loam of moderate prismatic and blocky structure. The B_{3g} horizon of olive-gray, distinctly mottled, gleyed, firm clay loam overlies mottled, gleyed clay loam C_{gcs} and C_{gcacs} horizons. Leota silty clay loam, nearly level, is the only Leota soil mapped in Brookings County.

Most areas of this soil that occur on upland flats are used for corn, small grains, and some alfalfa; areas in drainageways are generally left in grass.

The following is a profile description of Leota silty clay loam (fig. 24):

A_{11} 0 to 7 inches, very dark gray to very dark grayish-brown (2.5Y 3/1, dry) and black (1Y 2/1, moist), very friable, noncalcareous silty clay loam; weak to moderate very fine subangular blocky structure; lower boundary clear and smooth.

A_{12} 7 to 10 inches, dark-gray to dark grayish-brown (2.5Y 4/1, dry) and black (1Y 2/1, moist), friable, noncalcareous silty clay loam; weak medium and coarse prismatic structure that breaks to weak fine platy; lower boundary clear and smooth.

B_1 10 to 16 inches, gray to grayish-brown (2.5Y 5/1, dry) and black (1Y 2/1, moist), friable, noncalcareous, heavy silty clay loam; weak medium and coarse prismatic structure that breaks to weak to moderate medium subangular blocky; thin, patchy clay skins on faces of peds; lower boundary smooth.

B_2 16 to 24 inches, dark grayish-brown to grayish-brown (2.5Y 4.5/2, dry) light clay loam with fine, indistinct, yellowish-brown (10YR 5/8) mottling, and very dark gray to very dark grayish-brown (2.5Y 3/1, moist) light clay loam with fine, indistinct, yellowish-brown (10YR 5/8, moist) mottling; friable to firm; noncalcareous; weak to moderate and moderate medium and coarse prismatic structure that breaks to moderate fine and very fine subangular blocky; thin continuous clay skins on faces of peds; lower boundary smooth.

B_{3g1} 24 to 40 inches, gray to olive-gray (5Y 5/1.5, dry) light clay loam distinctly mottled with yellowish brown (10YR 5/8, dry) and olive-gray to olive (5Y 4/2.5, moist) light clay loam, distinctly mottled with yellowish brown (10YR 5/8, moist); firm; noncalcareous; weak coarse prismatic structure that breaks to weak to moderate fine and very fine subangular blocky; thin, patchy clay skins on faces of peds; lower boundary smooth.

B_{3g2} 40 to 48 inches, mottled light olive-gray and yellowish-brown (5Y 6/2 and 10YR 5/8, dry) to olive-gray and yellowish-brown (5Y 5/2 and 10YR 5/8, moist), firm, noncalcareous clay loam; weak to moderate very fine subangular blocky structure; weak, very patchy clay skins on faces of peds.

C_{gcs} 48 to 54 inches, mottled light olive-gray to pale-olive, white, and yellowish-brown (5Y 6/3, 10YR 5/8 and 8/1, dry), and olive-gray, white, and yellowish-brown (5Y 5/2, 8/1, and 10Y 5/8, moist), firm, weakly calcareous light clay loam; massive structure; salts, occurring as nests and as large soft segregations, are common.

C_{gcacs} 54 to 60 inches, mottled grayish-brown, white, and yellowish-brown (2.5Y 5/2, 8/1, and 10YR 5/8, dry), and dark grayish-brown, white, and yellowish-brown (2.5Y 4/2, 8/1, and 10YR 5/8, moist), firm, moderately calcareous light clay loam; con-

***Figure 24.*—Leota silty clay loam.**

tains a few large, soft segregations of lime and a few salt nests and medium, soft salt segregations.

Location of profile: Sec. 4, T. 111 N., R. 48 W.; 0.3 mile W. and 100 yards N. of the SE. corner.

Leota silty clay loam, nearly level (0 to 2 percent slopes) (Lb; subgroup 8B).—This soil occurs in soil area 31. It is the poorly drained member of the catena that includes the moderately well drained Lismore and the well drained Vienna soils. In this broad association it occurs on the slightly depressed upland flats and in the lower parts of the depressed dendritic drains. Both the flats and the drains occur within the nearly level and gently sloping areas of the associated Vienna and Lismore soils. The Leota soil differs from the Hidewood soil in having developed on till instead of loess.

Lismore soils

The Lismore soils in Brookings County are moderately well drained Chernozems that have developed under tall and mid grass associations in calcareous, friable to firm clay loam glacial till. They occur (1) on nearly level basal ground moraine; (2) on level to nearly level upland flats; (3) on nearly level, rather broad ridgetops and drainage divides; and (4) in the slightly depressed, upland drains at the higher ends of the well-developed dendritic drainage pattern that is common in the Iowan-Tazewell landscape.

The A_1 horizon of the Lismore soils is thick, black, friable, granular silty clay loam. It grades into a B_2 horizon of grayish-brown, friable clay loam that has a weak to moderate compound prismatic and blocky structure. The B_2 horizon grades into a B_{3ca} horizon of grayish-brown, friable clay loam of weak to moderate compound prismatic and blocky structure. The B_{3ca} horizon grades into olive-brown, friable to firm, massive or horizontal blocky loam and clay loam glacial till. The Lismore soils in Brookings County are silty clay loams. In these soils the strength of horizon development varies with the amount of worm working. This characteristic ranges from slight to moderate, the modal condition being somewhat less than moderate.

The Lismore soils are the moderately well drained catenal associates of the well drained Vienna soils and the somewhat poorly drained Leota soils. They differ from the Aastad soils of the Barnes catena in having developed in clay loam instead of friable loam till and in showing some worm working. They also differ from the Oak Lake soils of the Singsaas catena. Because of almost complete worm working, Oak Lake soils have little if any horizon development.

The Lismore soils are used almost entirely for corn, small grains, and alfalfa.

The following is a profile description of Lismore silty clay loam (fig. 25):

A_{1p} 0 to 5 inches, very dark gray (10YR 3/1, dry) to black (1Y 2/1, moist), friable, noncalcareous silty clay loam; cloddy to weak fine granular structure; a smooth false boundary.

A_{11} 5 to 16 inches, very dark gray (10YR 3/1, dry) to black (10YR 2/1, moist), friable, noncalcareous silty clay loam; weak coarse and medium prismatic structure that breaks to weak fine and very fine blocky; boundary obscured by worm working.

B_2A_1 16 to 20 inches, very dark gray to dark gray (10Y 3.5/1) clay loam, mottled with light olive-brown (2.5Y 5/4, dry) worm casts and filled worm channels, and black and dark grayish-brown to olive-brown (10YR 2/1 and 2.5Y 4/3, moist) clay loam; friable; noncalcareous; weak to moderate coarse prismatic structure that breaks to weak fine and very fine blocky; thin, very patchy clay skins on faces of peds; boundary obscured by worm working.

B_2 20 to 25 inches, dark-gray (2.5Y 4/1) clay loam, mottled with grayish-brown to light olive-brown (2.5Y 5/3, dry) worm casts and filled worm channels, to very dark gray and grayish-brown to olive-brown (2.5Y 3/1 and 4/3, moist) clay loam; friable; noncalcareous; weak to moderate medium prismatic structure that breaks to weak to moderate fine and medium blocky; thin continuous and thick patchy clay skins on faces of peds; boundary obscured by worm working.

B_{3ca} 25 to 34 inches, light brownish-gray to light yellowish-brown (2.5Y 6/3, dry) and grayish-brown to light olive-brown (2.5Y 5/3, moist), friable clay loam; contains a noncalcareous matrix mottled with moderately calcareous worm casts and filled worm channels that contain a few very small, soft lime segregations; weak to moderate medium prismatic structure that breaks to weak to moderate medium and fine blocky; thin continuous and thick patchy clay skins on faces of peds; boundary obscured by worm working.

$C_{ca}1$ 34 to 46 inches, clay loam glacial till that is light brownish gray to light yellowish brown, mottled with white (2.5Y 6/3 and 8/0, dry) and light olive brown mottled with white (2.5Y 5/4 and 8/0, moist); medium, soft segregations of lime and medium, hard concretions of lime are common; friable; strongly calcareous; massive to horizontal blocky structure; thin, very patchy clay skins on structured till decrease with depth; lower boundary irregular.

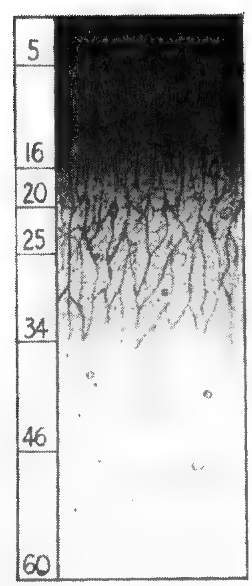

***Figure 25.*—Lismore silty clay loam.**

$C_{ca}2$ 46 to 60 inches, clay loam glacial till that is light brownish gray to light yellowish brown mottled with light olive brown and white (2.5Y 6/3, 5/6, and 8/0, dry) and grayish brown to light olive brown mottled with olive brown and white (2.5Y 5/3, 4/4, and 8/0, moist); large, soft segregations of lime and medium, hard concretions of lime are common; friable to firm; strongly calcareous; massive to horizontal blocky structure.

Location of profile: Sec. 26, T. 109 N., R. 48 W., 75 feet E. and 55 feet N. of the W. ¼corner.

Lismore silty clay loam, nearly level (0 to 2 percent slopes) (Lc; subgroup 1A).—This soil occurs on nearly level basal ground moraine; level to nearly level upland flats; and on nearly level, rather broad, flowing ridgetops and drainage divides. It is associated with the well-drained Vienna soils. Lismore silty clay loam, nearly level, is similar in profile to Lismore silty clay loam, drainageways, but because of its position it does not show the effect of colluvium and alluvium which is not the case for Lismore silty clay loam, drainageways. This unit occurs in soil area 31.

Lismore silty clay loam, drainageways (Ld; subgroup 1B).—This moderately well drained soil has developed in calcareous, friable to firm clay loam glacial till that has a variably shallow mantle of colluvium and alluvium. The soil occurs in the uplands in the slightly depressed higher ends of the well-developed dendritic drainage pattern of the Iowan and Tazewell landscapes. In these positions it is associated with the well-drained Vienna soils and more closely associated with the somewhat poorly drained Leota silty clay loam, nearly level. The soil has a profile similar to that of Lismore silty clay loam, nearly level, but differs from this soil because of the effect of colluvium and alluvium. This unit occurs in soil area 31.

Maddock series

The Maddock soils in Brookings County are well-drained Regosol-Chernozem intergrades that have developed in the uplands under mixed tall and mid grass associations in deep, moderately coarse and coarse eolian deposits. These soils occur in broad association with the Dickey, Egeland, and Flandreau soils on nearly level to undulating uplands that normally border stream valleys or prominent glacial channels (fig. 26).

Maddock soils have a black, very friable A_1 horizon that is transitional to a very dark grayish-brown, very friable B horizon of compound prismatic-blocky structure. The B horizons grade into a loose, massive to single-grain C horizon, which is underlain by a loose, strongly calcareous C_{ca} horizon. Sandy loam is the only soil type of the Maddock series mapped in Brookings County.

The Maddock soils of Brookings County differ from the Maddock series as mapped in other counties in having considerably thinner A_1 horizons and B horizons of weak color and structure. The Maddock soils differ from the associated Dickey, Egeland, and Flandreau soils. They are deeper to the till substratum than the Dickey, and are more coarse textured than the Egeland. Their solum is not medium-textured loess like that of Flandreau soils.

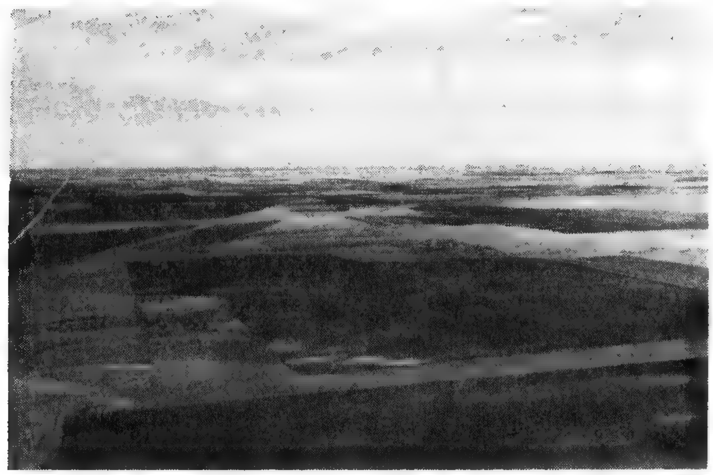

Figure 26.—**Maddock sandy loam (light areas) near Bruce.**

Most areas of Maddock soils are used for small grains and corn, but some areas are left in grass for pasture or hay.

The following is a profile description of Maddock sandy loam (fig. 27):

A_{1p} 0 to 8 inches, very dark gray (10YR 3/1, dry) to black (10YR 2/1, moist), very friable, noncalcareous light sandy loam; weak fine crumb structure; lower boundary clear and smooth.

B_2 8 to 21 inches, dark-gray (10YR 4/1.5, dry) to very dark gray (10YR 3/1.5, moist), very friable, noncalcareous loamy sand; weak coarse prismatic structure that breaks to weak coarse blocky; lower boundary smooth.

C_1 21 to 48 inches, dark grayish-brown (1Y 4/2, dry) to very dark gray (10YR 3/1.5, moist), loose, noncalcareous sand on the loamy sand boundary; single-grain structure.

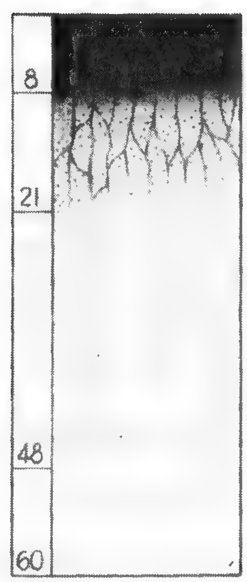

Figure 27.—**Maddock sandy loam.**

C_{ca} 48 to 60 inches, light brownish-gray (2.5Y 6/2, dry) to dark grayish-brown (2.5Y 4/2, moist), loose, strongly calcareous loamy sand on the sandy loam boundary; single-grain structure.

Location of profile: Sec. 24, T. 111 N., R. 51 W.; 0.2 of a mile N. of and 120 feet E. of the SE. corner.

Maddock sandy loam, nearly level (0 to 2 percent slopes) (Ma; subgroup 7B).—This soil occurs in soil area 32. It is more closely associated with Maddock sandy loam, undulating, than with Dickey, Egeland, and Flandreau soils. It has a profile similar to that of Maddock sandy loam, undulating.

Maddock sandy loam, undulating (3 to 8 percent slopes) (Mb; subgroup 7B).—This soil occurs on undulating positions, usually where the slopes break from the nearly level upland to the level bottom land. The soil is associated with Dickey, Egeland, and Flandreau soils and with Maddock sandy loam, nearly level.

Marsh

Marsh (Mc; subgroup 8D).—This mapping unit includes soils in the very poorly drained range of the Parnell series. These soils consist of moderately fine and fine textured local alluvium that has been washed into depressions of various sizes. Local relief in the depressions varies in relation to the upland. The depressions are normally ponded with 1 to 3 feet of water and have fairly dense growths of cattails, reeds, sedges, and other hydrophytic plants. In some larger depressions Marsh occurs in fairly close association with the poorly drained Parnell silty clay loam, nearly level.

Moody series

The Moody soils in Brookings County are well-drained Chernozems that have developed under tall grasses in deep, calcareous, medium-textured loess, which is underlain by friable to firm loam and clay loam glacial till. These soils occur on nearly level and gently sloping uplands on the Iowan and Tazewell drift sheets. They are rather closely associated with the Kranzburg, Brookings, and Hidewood soils. The Moody soils have profiles similar to those of the Kranzburg soils that developed east of the Big Sioux River in Brookings County. They differ from these Kranzburg soils primarily in having developed in slightly deeper loess that overlies a glacial till substratum. Further studies of these soils in adjacent areas may bring about a redefinition of their characteristics and, possibly, changes in their classification and name.

Moody silt loam, nearly level (0 to 2 percent slopes) (Md; subgroup 2A).—In catenal relationship and position this soil is similar to Kranzburg silt loam, nearly level, and Kranzburg loam, nearly level, but it somewhat differs from them in profile. Moody silt loam, nearly level, has a C_{ca} instead of the D_{ca} horizon of Kranzburg silt loam, nearly level, and Kranzburg loam, nearly level; and it differs from the Kranzburg loam in texture of the surface soil. This unit occurs in soil area 30.

Moody silt loam, gently sloping (3 to 4 percent slopes) (Me; subgroup 2B).—This soil is similar in catenal relations and position to Kranzburg silt loam, gently sloping, and Kranzburg loam, gently sloping, but it differs from them in profile. It has a C_{ca} horizon instead of the D_{ca} horizon of those Kranzburg soils. It differs from the Kranzburg loam in texture of the surface soil. Moody silt loam, gently sloping, has a profile similar to that of Moody silt loam, nearly level, but differs in slope. This unit occurs in soil area 30.

Oak lake series

The Oak Lake soils in Brookings County are moderately well drained, completely worm worked Chernozems. They have developed under tall and mid grass associations in loam-clay loam glacial till of Cary age or in local alluvium from this material. This alluvium overlies the till at varying shallow depths. The soils occur on level and nearly level upland flats and in sightly depressed upland drainageways.

The different horizons of the Oak Lake soils have been almost obliterated by worm working. The moderately thick, black A_1 horizon can be recognized, but it is transitional to other horizons that are completely mixed. The B_2 horizon may be mixed with the A_1, the A_1 with B_{2ca}, the B_{2ca} with C_{ca}, or these horizons may be mixed in different combinations. The mottled light brownish-gray C_{ca} horizon is comparatively unmixed. Oak Lake silt loams and silty clay loams occur in Brookings County. The main variations in these soils are caused by the amount of worm working.

The Oak Lake soils are the moderately well drained catenal associates of the well drained Singsaas soils. They differ from the moderately well drained Lismore soils, which have developed in clay loam till on smooth, flowing, Iowan and Tazewell ground moraine. The profiles of the Lismore soils show some worm working, but their horizons have not been obliterated. Oak Lake soils differ from the modal Aastad soils to the north, which do not show worm working and the accompanying morphological changes.

The Oak Lake soils are used primarily for corn, small grains, and alfalfa. In drainageways some of it is grassed.

The following is a profile description of Oak Lake silt loam (fig. 28):

A_{1p} 0 to 7 inches, very dark grayish-brown to dark grayish-brown (1Y 3.5/2, dry) to black (1Y 2/0.5, moist), very friable silt loam; noncalcareous to very slightly calcareous in worm casts and filled worm channels; weak to moderate fine blocky structure that breaks to weak to moderate fine granular; this layer has a false boundary.

A_1B_{2ca} 7 to 11 inches, almost complete worm working leaves no recognizable matrix color for the friable loam; mottles made by the worm casts and the very dark gray and light-gray (1Y 3/0.5 and 2.5Y 7/2, dry) to black and grayish-brown to light-brown (1Y 2/0.5 and 2.5Y 5/2.5, moist) filled worm channels are almost coalescent; noncal-

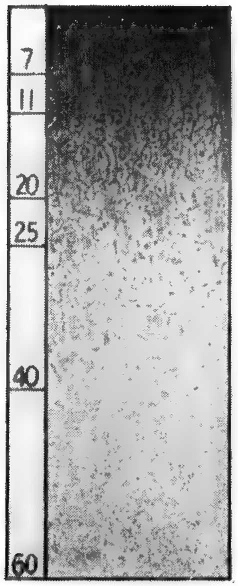

Figure 28.—Oak Lake silt loam.

careous to strongly calcareous in casts and filled worm channels; moderate fine subangular blocky structure; thin, very patchy clay skins on faces of structural peds; boundary not discernible because of worm activity.

$B_{2ca}C_{ca}$ 11 to 20 inches, almost complete worm working leaves no recognizable matrix color for the friable to firm, strongly calcareous loam; mottles made by worm casts and the dark grayish-brown to grayish-brown and light grayish-brown (2.5Y 4.5/2 and 6/2, dry) to very dark grayish-brown and dark grayish-brown to olive-brown (2.5Y 3/2 and 4/2.5, moist) filled worm channels are almost coalescent; moderate fine subangular blocky structure; thin, very patchy clay skins on faces of peds; boundary not discernible because of worm activity.

$C_{ca}B_{2ca}$ 20 to 25 inches, almost complete worm working leaves no recognizable matrix color for the friable to firm, strongly calcareous clay loam; mottles made by the worm casts and the dark grayish-brown and light brownish-gray (2.5Y 4/2 and 6/2, dry) to very dark grayish-brown and grayish-brown to light olive-brown (2.5Y 3/2 and 5/2, moist) filled worm channels are almost coalescent; weak to moderate fine subangular blocky structure; boundary obscured by worm working.

C_{ca} 25 to 40 inches, light brownish-gray to light yellowish-brown mottled with white and yellowish brown (2.5Y 6/2.5, 8/0, and 10YR 5/8, dry) and olive-brown to light olive-brown, white, and yellowish-brown (2.5Y 4.5/4, 8/2, and 10YR 5/8, moist) clay loam glacial till; friable to firm; strongly calcareous; massive structure; lower boundary smooth.

C 40 to 60 inches, light brownish-gray to light yellowish-brown mottled with gray and yellowish brown (2.5Y 6/2.5, 6/0, and 10YR 5/8, dry) and olive-brown to light olive-brown, gray, and yellowish-brown (2.5Y 4.5/4, 5/0, and 10YR 5/8, moist) loam glacial till; friable to firm; strongly calcareous; massive structure.

Location of profile: Sec. 9, T. 112 N., R. 47 W.; 0.3 of a mile S. of the NE. corner.

Oak Lake silt loam, nearly level (0 to 2 percent slopes) (Oa; subgroup 1A).—This soil has developed in loam-clay loam glacial till. It occurs on the level and nearly level upland flats that are superimposed over the more undulating positions on which the associated well-drained Singsaas soils occur. In profile it is similar to Oak Lake silty clay loam, drainageways, but it differs in that it shows little if any influence of colluvium and alluvium. This soil occurs primarily in soil area 50.

Oak Lake silty clay loam, drainageways (Ob; subgroup 1B).—This soil has developed in variably shallow colluvium and alluvium over loam-clay loam glacial till. It occurs in slightly depressed upland drainageways and in overflow channels between sloughs and between other more poorly drained areas. These drainageways occur below the slopes occupied by the well-drained Singsaas soils. Oak Lake silty clay loam, drainageways, is similar to Oak Lake silt loam, nearly level, but it shows influence of colluvium and alluvium to various degrees. The soils of this unit are primarily in soil area 50 but commonly occur in soil area 51 also.

Oldham series

The Oldham soil in Brookings County is a somewhat poorly drained, calcareous Chernozem-Humic Gley intergrade that has developed under mixed tall grasses and sedges in till or local alluvium from till. The soil occurs in depressions with widely variable local relief. It may occur (1) in small upland swales; (2) in shallow depressions where local relief is 1 to 3 feet; (3) in larger, deeper, flat-bottomed depressions where local relief is as great as 10 or 15 feet; (4) as rims or borders around large and very large, flat-bottomed, deep, more poorly drained depressions that have strong local relief; or (5) on the entire floor where the flat-bottomed depressions have been artificially drained.

The Oldham soils have a black, calcareous, granular A_1 horizon. Their B_2 horizon is dark gray to black, mottled with white. It is gleyed, strongly calcareous, and of prismatic and blocky structure. The C_{ca} horizon is dark gray, mottled with white, gleyed, strongly calcareous, and massive. Silt loam and silty clay loam types are recognized within the Oldham series, but in Brookings County only silty clay loam, nearly level, is mapped.

This Oldham soil differs from the Flom soils in being calcareous throughout and in showing the dark colors to greater depths. The Oldham soil is a Chernozem-Humic Gley intergrade, whereas the Flom soils are Humic Gleys. The Oldham soil is the somewhat poorly drained associate of the poorly and very poorly drained Parnell soils. The separation of these two series was made largely on the basis of artificial drainage and type of cover. The Oldham soil differs from the Vallers soils in that it is not a Solonchak.

The extent of cultivation of the Oldham soil depends somewhat on the landscape pattern, but it depends much more on the effect of the weather, espe-

cially the amount of summer and winter precipitation in any one year.

The following is a profile description of Oldham silty clay loam (fig. 29):

A_{10} 0 to 9 inches, very dark gray (3/0, dry) to black (2/0, moist), friable to firm, strongly calcareous silty clay loam; weak fine granular structure.

A_{11} 9 to 14 inches, very dark gray (3/0, dry) to black (2/0, moist) strongly calcareous silty clay loam; strong fine granular structure.

B_{2gca} 14 to 38 inches, dark-gray and white (5Y 4/1 and 8/0, dry) to black and white (10YR 2/1 and 8/0, moist), strongly calcareous silty clay loam; contains many lime segregations; weak coarse prismatic structure that breaks to strong fine granular.

C_{gca} 38 to 60 inches, dark-gray and white (2.5Y 4/1 and 8/0, dry), to very dark grayish-brown and white (2.5Y 3/2 and 8/0, moist), strongly calcareous, massive clay loam; contains many lime segregations.

Location of profile: Sec. 17, T. 110 N., R. 51 W.; 100 feet N. and 110 feet W. of the S. ¼ corner.

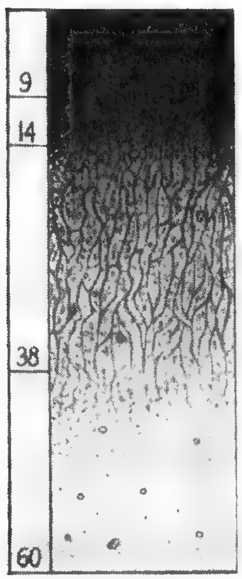

Figure 29.—Oldham silty clay loam.

Oldham silty clay loam, nearly level (0 to 2 percent slopes) (Oc; subgroup 8B).—This soil occurs in soil area 60. The Oldham and the Parnell soils occur in similar positions in the landscape. The positions in which this Oldham soil occurs are given in the series description.

Parnell series

The Parnell soils in Brookings County are poorly and very poorly drained and of questionable great soil group classification. They have developed under different types of vegetation in materials that are primarily local alluvium. These soils occur in depressions of diverse local relief. In this respect the Parnell soils are similar to the Oldham soils. The Parnell soils may occur (1) in small shallow depressions with a local relief of 1 to 3 feet; (2) in larger, deeper, flat-bottomed, undrained depressions with local relief as great as 10 or 15 feet; or (3) as rims around large marsh areas where the very poorly drained Parnell soils occur. The Parnell soils are the poorly and very poorly drained associates of the somewhat poorly drained Oldham soils. The two series are separated largely on the basis of artificial drainage and type of vegetation. The poorly drained Parnell soils differ from the very poorly drained Parnell soils in some profile characteristics.

The following is a profile description of Parnell silty clay loam, poorly drained (fig. 30):

A_0 0 to 1½ inches, very dark grayish-brown (10YR 3/2, dry and moist), very friable, noncalcareous peaty material; lower boundary clear and smooth.

A_0-A_1 1½ to 6 inches, very dark gray (10YR 3/1, dry) and black (1Y 2/1, moist), very friable, noncalcareous, light silty clay loam mixed with peaty material; weak fine granular structure; lower boundary clear and smooth.

A_1 6 to 12 inches, dark-gray, indistinctly mottled with dark brown (10YR 4/1 and 4/3, dry) and black, and very dark grayish-brown (10YR 2/1 and 3/2, moist) silty clay loam; friable; noncalcareous; weak medium prismatic structure that breaks to weak medium blocky; lower boundary clear but irregular.

(A_2)-B_{2g} 12 to 16 inches, dark-gray indistinctly mottled with dark brown (10YR 4/0.5 and 4/3, dry) and black and very dark grayish-brown (10YR 2/1 and 3/2, moist) silty clay; contains many hard shotlike concretions of iron and manganese; friable; noncalcareous; weak medium prismatic structure that breaks to weak to moderate fine and very fine platy; thin continuous clay skins on vertical ped surfaces; lower boundary irregular.

(B_2)-B_{22g} 16 to 32 inches, dark-gray indistinctly mottled with dark brown (10YR 4/0.5 and 4/3, dry), and black to very dark gray and very dark grayish-brown (10YR 2.5/1 and 3/2, moist) heavy silty clay; very firm; noncalcareous; moderate coarse prismatic structure that breaks to medium prismatic and, in turn, to weak to moderate very fine subangular blocky; thin continuous and thick patchy clay

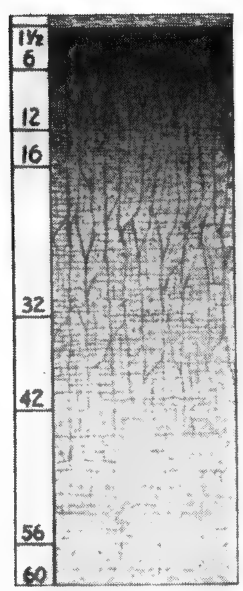

Figure 30.—Parnell silty clay loam, poorly drained.

skins on vertical and horizontal surfaces of peds; hard shotlike concretions of iron and manganese are common; lower boundary irregular.

(B_2)-B_{23g} 32 to 42 inches, gray to grayish-brown very indistinctly mottled with dark grayish-brown to olive brown (2.5Y 5/1 and 4/3, dry) and very dark gray and dark grayish-brown (10YR 3/1 and 4/2, moist) clay; very firm; noncalcareous; weak coarse prismatic structure that breaks to weak to moderate very fine subangular blocky; thin, very patchy clay skins on vertical surfaces of peds; contains a few hard shotlike concretions of iron and manganese.

(B_3)-C_{g1} 42 to 56 inches, dark-gray very indistinctly mottled with dark grayish brown to olive brown (2.5Y 4/1 and 4/3, dry) and black and dark grayish-brown to olive brown (10YR 2/1 and 4/3, moist) heavy silty clay; very firm; noncalcareous; massive to weak very fine subangular blocky structure.

(C)-C_{g2} 56 to 65 inches, heavy silt clay; when dry, dark gray very indistinctly mottled with dark grayish brown and dark grayish brown to olive brown (2.5Y 4/1, 4/2, and 4/3); when moist very dark gray, dark grayish brown, and dark grayish brown to olive brown (10YR 3/1, 4/2 and 4/3); very firm; noncalcareous; massive to weak very fine subangular blocky structure.

Location of profile: Sec. 17, T. 111 N,. R. 51 W.; 0.6 mile W. and 300 feet N. of SE. corner.

The classification of the foregoing profile of Parnell silty clay loam, poorly drained, is questionable. The horizon designations in parentheses appear to be the relict horizons of a solodized Solonetz or Soloth, over which the gleyed characteristics represented by the present horizon designations have been superimposed. This soil usually is not ponded. Possibly it should be classified as a Soloth-Humic Gley intergrade.

The following is a profile description of Parnell silty clay loam, very poorly drained:

A_{00} 2 to 0 inch, grayish-brown (2.5Y 5/2, dry) and very dark grayish-brown (2.5Y 3/2, moist), weakly calcareous, matted, undecomposed peaty material; shells scattered on the surface; lower boundary clear but irregular.

A_0A_1 0 to 6 inches, very dark gray (5Y 3/1, dry) and black (10YR 2/1, moist), very friable, weakly calcareous heavy silty clay loam; weak fine granular structure; mineral material mixed with peaty material; shells common; lower boundary clear but irregular.

(A_2)-A_{1g} 6 to 16 inches, gray to grayish-brown (2.5Y 5/1, dry) silty clay strongly mottled with yellowish-brown iron stains (10YR 5/8, dry) and very dark gray to very dark grayish-brown (2.5Y 3/1, moist) silty clay mottled with yellowish brown (10YR 5/8, moist); friable; moderately calcareous; moderate fine and medium platy structure that breaks to moderate fine and medium subangular blocky; moderate patchy clay skins on faces of peds; contains a few scattered shells; lower boundary smooth.

(A_2)-G_1 16 to 22 inches, grayish-brown (2.5Y 5/2, dry) heavy silty clay strongly mottled with yellowish-brown iron stains (10YR 5/8, dry), and very dark gray to very dark grayish-brown (2.5Y 3/1, moist) mottled with yellowish brown (10YR 5/8, moist) heavy silty clay; firm; moderately calcareous; weak coarse and medium prismatic structure that breaks to weak to moderate fine platy and, in turn, to weak to moderate very fine subangular blocky; moderate patchy clay skins on the faces of peds; lower boundary clear but irregular.

(A_2B_2)-G_2 22 to 28 inches, gray (5Y 5/1, dry) and very dark gray (5Y 3/1, moist), firm, strongly calcareous silty clay; weak medium prismatic structure that breaks to weak very fine subangular blocky; thin, very patchy clay skins on faces of peds; lower boundary clear but irregular.

(B_{21})-C_{g1} 28 to 40 inches, dark-gray (5Y 4/1, dry and moist), very firm, moderately calcareous, massive, heavy silty clay.

(B_{22})-C_{gcs1} 40 to 52 inches, very dark gray (5Y 3/1, dry) and black (2.5Y 2/1, moist), very firm, weakly calcareous, massive heavy silty clay; contains nests of gypsum crystals.

(B_3)-C_{gcs2} 52 to 60 inches, dark-gray to gray mottled with olive (5Y 4.5/1 and 5/3, dry), and very dark gray and olive-gray to olive (5Y 3/1 and 4/3, moist) silty clay; very firm; weakly calcareous; massive structure; contains nests of gypsum crystals.

Location of profile: Sec. 6, T. 110 N., R. 52 W.; 0.1 mile N. and 25 yards E. of the SW. corner.

The classification of this profile is questionable. The horizon designations in parentheses appear to be the relict horizons of a solodized Solonetz or Soloth, on which the gleyed characteristics represented by the present horizon designations have been superimposed. This soil is usually ponded. Possibly it should be classified as a Soloth-Humic Gley intergrade. Soloths do occur in smaller upland depressions in this area.

The Parnell soils of Brookings County differ from the soils of the Parnell series as mapped in other counties. Both the poorly and very poorly drained soils appear to be Soloth-Humic Gley intergrades. In Brookings County the poorly drained Parnell soils are noncalcareous and, in contrast, the very poorly drained Parnell soils are calcareous throughout. Shells occur in the very poorly drained Parnell soils, but not in the poorly drained. In position and vegetation, the very poorly drained soils are most like Parnell soils. However, in this report areas of the very poorly drained soils have been handled as a land type and are called Marsh, and the soils of these areas are discussed in the profile description of Parnell silty clay loam, very poorly drained. The poorly drained areas are correlated and mapped as Parnell silty clay loam, nearly level.

Few, if any, areas of these soils are under cultivation, although some attempts are made to drain them for future cultivation.

Parnell silty clay loam, nearly level (0 to 2 percent slopes) (Pa; subgroup 8c).—This poorly drained soil has developed in till or in local alluvium derived from till. It occurs in depressions of widely variable local relief, and in this respect it is similar to the Oldham soils. Parnell silty clay loam, nearly level, occurs in soil area 60.

Pierce series

The Pierce soils are excessively drained Regosols that have developed under mixed mid and short grass associations in morainic outwash or mixed sandy and gravelly ice-contact-stratified drift. They occur on steep, broken, morainic landscapes or on kames and

eskers, either as independent units or in complexes with other soils.

The Pierce soils have a thin A_1 horizon of very dark brown to black, noncalcareous loam. The A-C transition horizon is very dark brown, weakly calcareous, and gravelly. It overlies a C_{ca} horizon of yellowish-brown, strongly calcareous, loose sand and gravel.

Most areas of these soils are in pasture or hay. Some areas that occur with deeper soils are cultivated along with them.

The following is a representative profile of Pierce loam (fig. 31):

A_1 0 to 3 inches, dark-gray to dark grayish-brown (10YR 4/1.5, dry) and very dark brown (10YR 2/2, moist), very friable, noncalcareous loam; weak fine granular and crumb structure; lower boundary clear and smooth.

A-C 3 to 12 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, dry) and very dark brown (10YR 2/2, moist) gravelly loam; very friable; weakly calcareous; weak fine granular and crumb structure; lower boundary clear and smooth.

C_{ca} 12 to 60 inches, yellowish-brown (10YR 5/6, dry) and yellowish-brown (10YR 5/4, moist), loose, strongly calcareous sand and gravel outwash; slight amount of lime segregated as crusts on the gravel.

Location of profile: Sec. 12, T. 111 N., R. 52 W.; 0.2 mile W. and 50 feet N. of SE. corner.

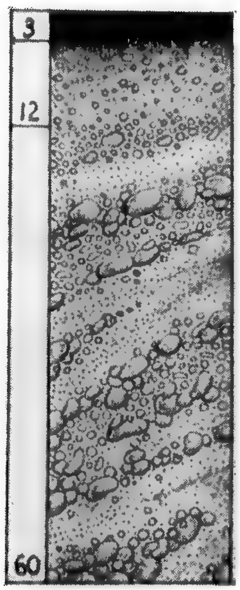

***Figure 31.*—Pierce loam.**

Pierce complexes, hilly (18+ percent slopes) (Pb; subgroup 5D).—This unit is a complex made up of a shallow, excessively drained Pierce soil that has developed in mixed sandy and gravelly stratified drift and of deeper, undifferentiated soils. The complex consists of about 75 percent Pierce soil and 25 percent undifferentiated soils. It occurs on steep, broken, morainic relief (soil area 70). The Pierce soil occurs on the knobs and steep, short, convex slopes that dominate the relief. The undifferentiated soils are scattered throughout the relief in alluvium and colluvium; they occur as slight saddles, shallow swales, and other land forms.

Poinsett series

The Poinsett soils are well-drained Chernozems that have developed under mixed tall and mid grass associations in stratified silty drift of late Wisconsin age (Cary substage). In Brookings County these soils occur on both terminal and ground moraines in dissimilar landscapes and in dissimilar soil patterns. Complexes of Poinsett, Buse, and Pierce soils occur on the knobby, broken, and generally rough parts of the terminal moraine (fig. 32). These rough parts are interlaced with a pattern of incompletely developed colluvial-alluvial drains and swales, more poorly drained depressions, and marshes.

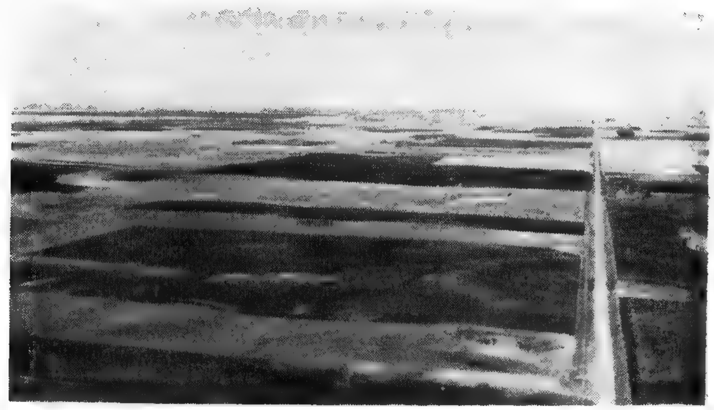

***Figure 32.*—Complex of Poinsett, Buse, and Pierce soils. Dark areas are Poinsett; white knobs are Buse or Pierce; Waubay soils in slight dips and channels. Gravel pit is in Pierce soil on knob.**

The Poinsett soils occur on the smoother parts of the terminal and ground moraines, where they are associated with the Waubay, Oldham, and Parnell soils. They also occur in broad association with the Sinai soils. The Sinai soils are on the nearly level mesalike hilltops, and the Poinsett soils extend down the side slopes of greater relief.

The Poinsett soils have a black, very friable, granular A_1 horizon. The dark grayish-brown, friable B horizon is of moderate prismatic and blocky structure and has little or no clay accumulation. The mottled C_{ca} horizon overlies a stratified, mottled C horizon. In Brookings County only silt loams are mapped in the Poinsett series. Because of their parent materials, the Poinsett soils differ in the amount and intensity of color and textural stratification. Profiles vary in stoniness. Some have only a few pebbles and coarse sand grains, but in others granitic stones and pebbles are common.

The catenal associates of the Poinsett soils are the moderately well drained Waubay soils, the somewhat poorly drained Oldham soils, and the poorly drained Parnell soils. The Poinsett soils differ from the Sinai soils primarily in having a coarser texture. The stratified, distinctly mottled substratum and the undulating

landscape of the Poinsett soils distinguish them from the Kranzburg soils. Kranzburg soils developed from a uniform mantle of loess that overlies glacial till, and they occur on a smooth landscape having a well-integrated pattern of surface drainage.

The Poinsett soils are primarily used for corn, small grains, and alfalfa. Some of the more strongly undulating areas are used for pasture or hay.

The following is a profile of Poinsett silt loam (fig. 33):

A_{1p} 0 to 6 inches, very dark grayish-brown to dark grayish-brown (10YR 3.5/2, dry) and black (10YR 2/1, moist), very friable, noncalcareous silt loam; weak fine granular structure; lower boundary clear and smooth.

B_1 6 to 9 inches, dark grayish-brown (10YR 4/2, dry) to very dark grayish-brown (10YR 3/2, moist), friable, noncalcareous loam, on the silt loam boundary; moderate medium blocky structure; thin, very patchy clay skins on faces of peds; lower boundary clear and smooth.

B_2 9 to 26 inches, grayish-brown to brown (1Y 5/2.5, dry) and dark-brown (1Y 4/2.5, moist), friable, noncalcareous loam; moderate medium and coarse prismatic structure that breaks to moderate medium blocky; thin, patchy clay skins on faces of peds; lower boundary clear and smooth.

C_{ca} 26 to 42 inches, loam, on the clay loam boundary; light brownish gray mottled with light olive brown and white (2.5Y 6/2, 5/4, and 8/0, dry) or grayish brown, olive brown, and white (2.5Y 5/2, 4/4, and 8/0, moist); segregated lime is common; firm; strongly calcareous; massive structure; textural stratification occurs in this horizon as thin layers of silt, fine sand, and clay; rather strong color stratification occurs as somewhat darker bands that are high in iron.

C_1 42 to 48 inches, light brownish-gray to light-gray and white (2.5Y 6.5/2 and 8/0, dry) and grayish-brown to light olive-brown and white (2.5Y 5/2.5 and 8/0, moist) loam; firm; moderately calcareous; massive structure; textural stratification is less than in layer above, and layers of silt, fine sand, and clay are slightly thicker.

C_2 48 to 52 inches, light-gray and yellowish-brown (2.5Y 7/1.5 and 10YR 5/8, dry) to grayish-brown and very pale brown (2.5Y 5/2 and 10YR 8/4, moist) sandy loam; friable; moderately calcareous; massive structure.

C_3 52 to 60 inches, light brownish-gray, light yellowish-brown to olive-yellow, and yellowish-brown (2.5Y 6/2, 6/5 and 10YR 5/8, dry) to grayish-brown, light olive-brown, and dark yellowish-brown (2.5Y 5/2, 5/6 and 10YR 4/4, moist) loam; firm; weakly calcareous; massive structure.

Location of profile: Sec. 31, T. 112 N., R. 52 W.; 0.2 mile N. of E. ¼ corner.

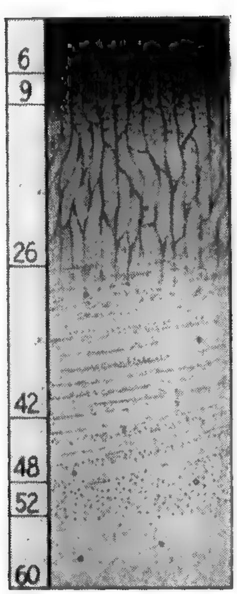

Figure 33.—**Poinsett silt loam.**

Poinsett silt loam, nearly level (0 to 2 percent slopes) (Pc; subgroup 2A).—This soil occurs on nearly level areas in an undulating or gently undulating landscape. It is broadly associated with Poinsett silt loam, gently undulating; Poinsett silt loam, undulating; the colluvial-alluvial Waubay soils; and the more poorly drained Oldham and Parnell soils. In this association, Poinsett silt loam, nearly level, occurs on the fairly broad, nearly level tops of the undulations and gentle undulations, and the other two Poinsett soils occur on the side slopes. Below these slopes the Waubay soils occur in the interwoven pattern of colluvial-alluvial drains and swales, and the Oldham and Parnell soils occur in the depressions. This soil unit occurs in soil area 40.

Poinsett silt loam, gently undulating (3 to 4 percent slopes) (Pd; subgroup 2C).—This well-drained soil has developed in stratified silty glacial drift. Its profile is similar to that of Poinsett silt loam, nearly level, and this soil extends down the gentle slopes from that nearly level soil. It has the same association with the Waubay, Oldham, and Parnell soils as Poinsett silt loam, nearly level. This unit occurs in soil area 40.

Poinsett silt loam, undulating (5 to 8 percent slopes) (Pe; subgroup 3B).—This soil has a slightly thinner A_1 horizon than Poinsett silt loam, nearly level, and Poinsett silt loam, gently undulating. It generally occurs on stronger slopes than Poinsett silt loam, gently undulating. In some places it occurs as isolated stronger slopes in areas of the gently undulating soil. Poinsett silt loam, undulating, has the same association with the Waubay, Oldham, and Parnell soils as Poinsett silt loam, nearly level. It occurs in soil area 40.

Poinsett-Buse-Pierce soils, gently undulating (3 to 4 percent slopes) (Pg; subgroup 5A).—This unit is a complex of Poinsett silt loam, Buse loam, and Pierce loam. The complex occurs on a gently undulating landscape that is interlaced with the young colluvial-alluvial drains and swales of Waubay silty clay loam, drainageways. The Poinsett loam is well drained and has developed in stratified, silty glacial drift. It is the predominant soil in this complex and occurs in the gently undulating positions.

The Buse loam is thin and somewhat excessively drained and has developed in stratified silty glacial drift. It is a minor member of the complex and occurs on the small knobs and short eroded slopes that are sparsely scattered throughout the gently undulating landscape.

The Pierce loam is very shallow and excessively drained and has developed in pockets of mixed sandy

and gravelly stratified drift. It is intermingled with the Buse loam as pockets on the small knobs and short eroded slopes.

This complex is composed of about 70 percent Poinsett soils, 15 percent Buse soils, and 15 percent Pierce soils. It occurs in soil area 43.

Poinsett-Buse-Pierce soils, undulating (5 to 8 percent slopes) (Ph; subgroup 5B).—This unit is a complex of Poinsett silt loam, Buse loam, and Pierce loam. The complex occurs on an undulating landscape that is interlaced with young colluvial-alluvial drains and swales and depressional sites (fig. 34). The drains and swales consist of Waubay silty clay loam, drainageways, and the depressional sites of Oldham silty clay loam, nearly level, and of Parnell silty clay loam, nearly level.

Figure 34.—**Poinsett-Buse-Pierce soils, undulating. The Waubay areas in dark pattern in upper center are shown separately on map.**

The Poinsett loam is well drained and has developed in stratified silty glacial drift. It is the predominant soil in the complex and occurs on the undulating positions.

The Buse loam, thin and somewhat excessively drained, has developed in stratified silty glacial drift. It occurs as rings on the short steeper side slopes around the undulations, or as eroded points and knobs rather evenly distributed throughout the undulating landscape.

The Pierce loam is very shallow and excessively drained. It has developed in pockets of mixed sandy and gravelly stratified drift. It is intermingled with the Buse loam as pockets on knobs and short steeper side slopes.

This complex is composed of about 65 percent Poinsett loam, 20 percent Buse loam, and 15 percent Pierce loam. It occurs in soil area 43.

Poinsett-Buse-Pierce soils, rolling (9 to 18 percent slopes) (Pk; subgroup 5c).—This unit is a complex of Poinsett silt loam, Buse loam, and Pierce loam. The complex occurs on a rolling, eroded, morainic landscape that is interlaced with the young colluvial-alluvial drains and swales and depressional sites. The drains and swales consist of Waubay silty clay loam, drainageways, and the depressional sites of Oldham silty clay loam, nearly level, and of Parnell silty clay loam, nearly level.

The Poinsett silt loam is well drained and has developed in the stratified silty glacial drift. It is the predominant soil in the complex and occurs in the smoother, less steep parts of the rolling landscape.

The Buse loam is thin and somewhat excessively drained and has developed in stratified silty glacial drift. It occurs as rings on the steep side slopes around the rolling hills and as eroded points and knobs throughout a rolling and knobby landscape.

The Pierce loam is very shallow and excessively drained and has developed in pockets of mixed sandy and gravelly stratified drift. It is complexly associated with the Buse loam and is intermingled with it as pockets.

This complex is composed of about 50 percent Poinsett silt loam, 25 percent Buse loam, and 25 percent Pierce loam. It occurs in soil area 43.

Rauville series

Rauville silty clay loam, nearly level, is the only Rauville soil mapped in Brookings County. It is a very poorly drained Humic Gley soil of the bottom lands. It has developed under marsh vegetation in medium-textured and moderately fine textured alluvium, which may be underlain by mixed sand and gravel or gravelly glaciofluvial materials. The Rauville soil occurs in old oxbows and small settling basins behind the natural stream levees. It is often ponded. It occurs in broad association with the Lamoure, Solomon, and Volga soils.

The Rauville soils have an A_1 horizon of black, weakly calcareous, mixed mineral and peaty silty clay loam. Their A_{1g} horizon is heavy silty clay loam that is mottled, black, moderately calcareous, and firm. In the BG horizon the heavy silty clay loam is mottled, very dark gray and grayish brown, weakly calcareous, and very firm. The BG horizon overlies very firm gravelly clay loam and loose gravel that is mottled, very dark gray and grayish brown, weakly calcareous, and stratified.

The Rauville soil is seldom if ever cultivated.

The following is a profile description of Rauville silty clay loam (fig. 35):

A_1A_0 0 to 2 inches, dark-gray (5Y 4/1, dry) and black (10YR 2/1, moist), very friable and firm, weakly calcareous silty clay loam with much peaty material in pockets and mixed with the mineral matter; weak fine granular structure; shells common on the surface and in the soil; lower boundary clear but irregular.

A_{11g} 2 to 7 inches, dark-gray to gray (5Y 4.5/1, dry) and black (10YR 2/1, moist), firm, moderately calcareous silty clay loam; weak medium platy structure; shells common; lower boundary smooth.

A_{12g} 7 to 14 inches, dark-gray indistinctly mottled with olive brown (5Y 4/1 and 2.5Y 4/4, dry) and black and dark-brown to brown (10YR 2/1 and 4/3, moist) heavy silty clay loam; very firm; moderately calcareous; very weak, very coarse prismatic structure; shells common; lower boundary smooth.

BG 14 to 30 inches, dark-gray indistinctly mottled with light gray (4/0 and 5Y 7/1, dry) and very dark

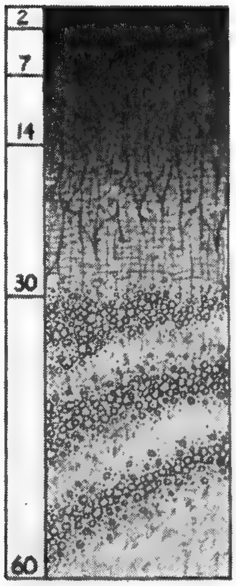

Figure 35.—**Rauville silty clay loam.**

gray and grayish-brown (2.5Y 3/1 and 5/2, moist) heavy silty clay loam; very firm; weakly calcareous; very weak coarse prismatic structure that breaks to moderate fine and medium subangular blocky; lower boundary smooth.

G 30 to 50 inches +, dark-gray indistinctly mottled with light gray (4/0 and 5Y 7/1, dry) and very dark gray and grayish-brown (2.5Y 3/1 and 5/2, moist) gravelly clay loam and loose gravel; stratified; weakly calcareous; very firm.

Location of profile: Sec. 15, T. 109 N., R. 49 W.; 0.45 mile W. and 25 feet S. of NE. corner.

Rauville silty clay loam, nearly level (0 to 2 percent slopes) (Ra; subgroup 8D).—This soil is a very poorly drained associate of the somewhat poorly drained Lamoure soils, the poorly drained Solomon soils, and the somewhat poorly and poorly drained Volga soils. It is often ponded.

The soil differs from the associated soils primarily in drainage. In some places this soil is similar to Marsh on upland areas. Rauville silty clay loam, nearly level, occurs in soil area 10.

Renshaw series

The Renshaw soils in Brookings County, are somewhat excessively drained Chernozems that have developed under mixed tall and mid grass associations in a thin mantle of loamy or moderately sandy glacial alluvium. The alluvium overlies outwash of sand and gravel. The soils occur in association with the Fordville and Sioux soils on level and nearly level stream terraces and outwash plains.

Renshaw soils have a black, granular A horizon that overlies a dark grayish-brown, prismatic and blocky B horizon. The B horizon overlies a D_{ca} horizon. The D_{ca} horizon occurs in the upper part of the thick beds of loose outwash gravel and sand of the D horizon. The Renshaw soils mapped in Brookings County are sandy loams. The thickness of the solum ranges from 10 to 20 inches, and the thickness of the individual horizons varies directly with the thickness of the solum.

The Renshaw soils are associated with the Fordville and Sioux soils. Normally the Renshaw are intermediate in thickness between the shallower Sioux and the deeper Fordville soils. Soils of these series, however, are not separated on the basis of their thickness. They are separated on the basis of morphology, as it affects the profile. The Renshaw soils have an A-B-D_{ca}-D profile; the shallower Sioux soils have an A-D_{ca}-D or A-D-D_{ca} profile; and the deeper Fordville soils have an A-B-C-D_{ca} or A-B-C_{ca}-D profile.

Much of the Renshaw acreage is cultivated, mainly to small grains, but some corn is grown. The remaining areas are used for native hay or for either tame or native pasture.

The following is a profile description of Renshaw sandy loam (fig. 36):

A_{1p} 0 to 4 inches, very dark gray (1Y 3/1, dry), to black (1Y 2/1, moist), soft, noncalcareous sandy loam; cloddy to weak fine granular structure; lower boundary clear and smooth.

B_1 4 to 9 inches, very dark gray to dark gray (1Y 3.5/1, dry), and black (10YR 2/1, moist), soft, noncalcareous sandy loam; weak coarse prismatic structure that breaks to weak to moderate fine and medium blocky and granular; lower boundary smooth.

B_2 9 to 15 inches, dark grayish-brown (1Y 4/2, dry) to very dark grayish-brown (10YR 3/2, moist), slightly hard, noncalcareous sandy loam; weak to moderate coarse and medium prismatic structure that breaks to weak to moderate medium blocky; thin, very patchy clay skins on faces of peds; lower boundary clear and smooth.

D_{ca} 15 to 22 inches, multicolored, moderately to strongly calcareous, loose, outwash gravel with segregated coatings of lime; lower boundary clear and smooth.

D 22 inches +, multicolored, weakly calcareous, loose, outwash gravel.

Location of profile: Sec. 12, T. 109 N., R. 50 W.; 50 feet S. and 50 feet E. of N. ¼ corner.

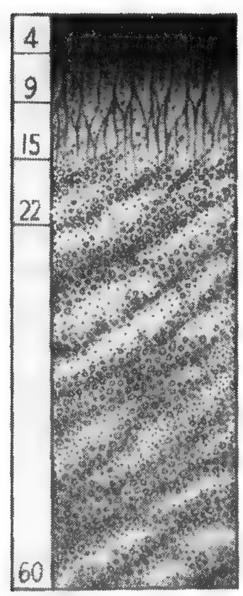

Figure 36.—**Renshaw sandy loam.**

Renshaw sandy loam, nearly level (0 to 2 percent slopes) (Rb; subgroup 6D).—This soil is broadly associated with the Fordville and Sioux soils. It occurs in positions similar to those of the associated soils but in no set pattern with them. Renshaw sandy loam, nearly level, occurs on stream terraces and outwash plains of slight relief. It differs in position from Renshaw sandy loam, gently sloping, which occurs on gently sloping terrace escarpments in broad association with some of the Sioux soils. This unit is in soil area 21.

Renshaw sandy loam, gently sloping (3 to 4 percent slopes) (Rc; subgroup 6D).—This soil is broadly associated with the Fordville and Sioux soils. It occurs in about the same position as the associated soils, but in no set pattern with them. It is on gentle slopes, usually on the fringes of the nearly level terraces and outwash plains on which Renshaw sandy loam, nearly level, and the Fordville soils occur. This soil occurs in area 21.

Sinai series

The Sinai soils in Brookings County are well-drained Chernozems that have some of the characteristics of young Grumusols. They have developed under mixed tall and mid grass associations in stratified silty and clayey glacial drift. They occupy the nearly level to gently sloping tops of mesalike hills (fig. 37).

***Figure 37.*—Sinai tableland in Winsor township, looking southeast. Marsh in foreground; Poinsett silt loam, gently undulating, beyond; Buse and Poinsett soils on escarpment; and Sinai soils on flat-topped hill in background.**

The Sinai soils have a black, granular A_1 horizon and a B_2 horizon that is dark grayish brown and of prismatic and blocky structure. Many vertical tongues of the A_1 horizon extend through the B_2 horizon. The olive-brown B_{3ca} horizon is prismatic and blocky, and tongues of the A_1 extend well into it, or even through it into the C_{ca} horizon. The C_{ca} horizon is in the upper part of the calcareous, mottled parent material that is of platy to horizontal blocky structure. The Sinai soils mapped in Brookings County are silty clay loams, but on the more nearly level areas they tend to be somewhat finer textured. In some areas gravel and stones occur in these soils.

The Sinai soils are associated with the Poinsett soils and differ from them primarily in being finer textured.

Almost all of the acreage of these soils is used for corn, small grains, and alfalfa.

The following is a representative profile of Sinai silty clay (fig. 38):

A_p 0 to 6 inches, very dark gray (10YR 3.5/1, dry) to black (10YR 2/1, moist) silty clay; very hard; friable; moderate fine granular structure; surface mulch in cultivated areas is of strong very fine granular structure; clear boundary, but tongues of this layer extend into horizon below.

B_{21} 6 to 12 inches, dark grayish-brown (10YR 4/2, dry) silty clay with tongues of very dark gray (10YR 3.5/1, dry); very hard; friable; compound structure, the weak medium prisms separating to moderate very fine blocks; moist soil is very dark brown (10YR 2.5/2) and crushes to very dark grayish brown (10YR 3/2, moist); grades in the lower part to very dark gray (10YR 3/1, moist) and crushes to very dark grayish brown (2.5Y 3/2, moist); surfaces of the moist aggregates glisten; gradual boundary; tongues of the 0- to 6-inch layer extend into horizon below.

B_{22} 12 to 19 inches, brown (1Y 5/3, dry) to dark grayish-brown (10YR 4/2, moist) silty clay; hard to very hard; friable; compound structure, the weak medium prisms separating to strong very fine blocks; surfaces of the moistened aggregates glisten; clear boundary but tongues of the 0- to 6-inch layer extend into horizon below.

B_{3ca} 19 to 26 inches, light brownish-gray (2.5Y 6/2, dry) to olive-brown (2.5Y 4/3, moist) moderately calcareous silty clay; moderate amount of lime segregated as small, soft concretions; very hard; friable; compound structure, the weak medium prisms separating to moderate fine blocks; moistened aggregates glisten; gradual boundary.

C_{ca} 26 to 35 inches, light-gray (5Y 6/1, dry) silty clay with many fine distinct mottles of brownish yellow (10YR 6/6, dry), dark grayish brown (2.5Y 4/2, moist), yellowish brown (10YR 5/6, moist), and gray (N 6/0, moist); moderately calcareous, with a moderate amount of lime in small, soft concretions; hard; firm; moderately developed very fine blocks; gradual boundary.

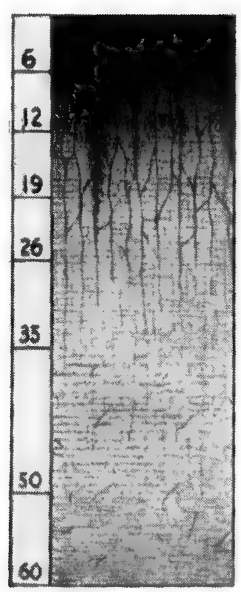

***Figure 38.*—Sinai silty clay.**

C_1 35 to 50 inches, light-gray (5Y 7/1, dry) silty clay with many fine prominent mottles of yellowish brown (10YR 5/6, dry), and gray (5Y 5/1, moist) and streaks of brown and dark brown; mildly calcareous, with a slight amount of lime in small soft concretions; hard; firm; moderate coarse platy structure that separates to strong fine angular blocks; many long tubular concretions of iron; gradual boundary.

C_2 50 to 60 inches, light-gray (5Y 7/1, dry) silty clay loam with many fine prominent mottles of yellowish brown (10YR 5/6, dry), very dark grayish brown (10YR 3/2, dry), gray (5Y 5/1, moist), and dark yellowish brown (10YR 4/4, moist); mildly calcareous; hard; firm; moderate coarse plates that separate to strong fine blocks; numerous long tubular concretions of iron.

Location of profile: Sec. 18, T. 109 N., R. 52 W.; 0.3 mile E. and 300 feet N. of SW. corner.

Sinai silty clay loam, nearly level (0 to 2 percent slopes) (Sa; subgroup 2D).—This soil occurs on the tops of mesalike hills. It is broadly associated with Poinsett soils, which are on the steeper side slopes of these hills. The mesalike hills are interlaced with a pattern of colluvial-alluvial drains and swales in which the associated Waubay soils occur. The drains form connecting channels between the depressional sites of Oldham silty clay loam, nearly level, and Parnell silty clay loam, nearly level, and the wetter sites of Marsh that dot the landscape. Sinai silty clay loam, nearly level, is in soil area 41.

Sinai silty clay loam, gently sloping (3 to 4 percent slopes) (Sb; subgroup 2D).—This soil occurs on gently sloping plains on the tops of mesalike hills. It is similar to Sinai silty clay loam, nearly level, in its association with the Poinsett, Waubay, Oldham, and Parnell soils. It differs from Sinai silty clay loam, nearly level, only in having developed in gently sloping rather than nearly level positions and in being slightly less fine textured. This unit occurs in soil area 41.

Sinai silty clay loam, sloping (5 to 8 percent slopes) (Sc; subgroup 3C).—This soil occurs on the sloping fringes and high saddles on the more nearly level plains on the tops of the mesalike hills, or on the more sloping tops of the mesalike hills. It is similar to the nearly level and gently sloping phases of Sinai silty clay loam in its broad association with the Poinsett, Waubay, Oldham, and Parnell soils. Sinai silty clay loam, sloping, differs from Sinai silty clay loam, nearly level, in having developed in sloping instead of nearly level positions and in being slightly less fine textured. It differs from the Sinai silty clay loam, gently sloping, in having developed in sloping instead of gently sloping positions. This unit occurs in soil area 41.

Singsaas series

The Singsaas soils in Brookings County are well-drained, worm-worked Chernozems that have developed under tall and mid grass associations in loam-clay loam glacial till of Cary age. They occur on nearly level to undulating and rolling ground moraine.

The worm activity has almost completely obliterated the horizons of the Singsaas soils and has distributed lime throughout the profile. The moderately thick, black A_1 horizon can be recognized, but it is transitional to other horizons that are completely mixed. The B_2 horizon may be mixed with the A_1, the B_{3ca} with the B_2, and the C_{ca} with the B_{3ca}, or these horizons may be mixed in different combinations. The mottled pale-yellow and yellowish-brown C_{ca} horizon is comparatively unmixed. In Brookings County, loam is the only type of the Singsaas series mapped.

The primary variations in these soils are caused by worm activity. The Singsaas soils are the well drained catenal associates of the moderately well drained Oak Lake soils. They differ from the well-drained Vienna soils, which are modally developed in clay loam till on the smooth ground moraine of the Iowan and Tazewell drift sheets. The slight worm activity in the Vienna soils causes few if any morphological changes.

Singsaas soils are mostly used for corn, small grains, and alfalfa.

The following is a profile description of Singsaas loam (fig. 39):

A_1 0 to 8 inches, very dark gray (10YR 3/1, dry) to black (1Y 2/1, moist), soft, noncalcareous loam; worm casts and filled worm channels are common; weak coarse prismatic structure; lower boundary irregular.

A_1B_2 8 to 15 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, dry) light clay loam, marked with numerous worm casts and worm channels that have been filled with B_2 materials, and mottled with black (10YR 2/1, moist); slightly hard; noncalcareous; weak coarse prismatic structure with short vertical axes; prismatic structure breaks to weak to moderate coarse and medium subangular blocky; thin, patchy clay skins on faces of peds; boundary not discernible because the soil has been mixed through worm activity.

B_2A_1 15 to 18 inches, clay loam; no recognizable matrix color, because of worm activity; mottling caused by worm casts and filled worm channels is almost coalescent; worm channels filled with very dark gray to very dark grayish-brown and dark grayish-brown (10YR 3.5/1 and 4/2, dry) to

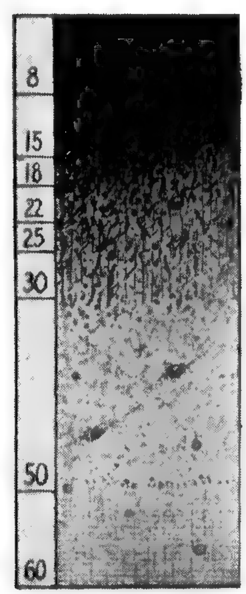

Figure 39.—Singsaas loam.

black and very dark grayish-brown (10YR 2/1 and 3/2, moist) clay loam; slightly hard; noncalcareous; weak coarse prismatic structure with short vertical axes; prismatic structure breaks to weak to moderate medium and fine subangular blocky; thin continuous clay skins on faces of peds; boundary not discernible because the soil has been mixed by worm activity.

B_2B_{3ca} 18 to 22 inches, clay loam with no recognizable matrix color; the mottling caused by worm casts and filled worm channels is almost coalescent; worm channels filled with very dark gray to very dark grayish-brown and grayish-brown (10YR 3.5/1 and 2.5Y 5/2, dry) to black and dark grayish-brown (10YR 2/1 and 2.5Y 3/2, moist) slightly hard clay loam; material within casts and worm channels ranges from noncalcareous to calcareous; weak prismatic structure, with short vertical axes, breaks to moderate medium and fine subangular blocky; thin continuous and thick very patchy clay skins on faces of peds; boundary not discernible because the soil has been mixed by worm activity.

$B_{3ca}B_2$ 22 to 25 inches, clay loam with no recognizable matrix color; the mottling caused by worm casts and filled worm channels is almost completely coalescent; worm channels filled with dark grayish-brown and light brownish-gray (2.5Y 4/2 and 6/2, dry) to very dark gray and grayish-brown to light olive-brown (1Y 3/1 and 2.5Y 5/3, moist) slightly hard clay loam; material within casts and worm channels ranges from noncalcareous to calcareous; weak to moderate coarse and medium prismatic structure, with short vertical axes; prismatic structure breaks to moderate medium and fine subangular blocky; thin continuous clay skins on faces of peds; boundary not discernible because the soil has been mixed through worm activity.

$B_{3ca}C_{ca}$ 25 to 30 inches, light brownish-gray to light yellowish-brown (2.5Y 6/3, dry) and dark grayish-brown to olive-brown (2.5Y 4/3, moist) slightly hard clay loam; material in worm casts and worm channels ranges from calcareous to strongly calcareous; few to common, small, soft segregations of lime in the strongly calcareous materials of casts and filled worm channels; weak coarse prismatic structure that breaks to weak to moderate coarse, medium, and fine subangular blocky; thin, patchy clay skins on faces of peds; boundary obscure because the soil has been mixed by worm activity.

C_{ca} 30 to 50 inches, pale-yellow mottled with light gray and yellowish brown (2.5Y 7/4, 7/0, and 10YR 5/8, dry) to light olive-brown, gray, and yellowish-brown (2.5Y 5/4, 6/0, and 10YR 5/8, moist) clay loam; few to common, small, soft lime segregations; slightly hard; strongly calcareous; weak medium blocky structure; thin, patchy clay skins on structural peds; lower boundary clear and smooth.

D 50 to 60 inches, light-gray to pale-yellow (2.5Y 7/3, dry) and grayish-brown to light olive-brown (2.5Y 5/3, moist) heavy clay loam glacial till; hard; calcareous; horizontal blocky structure; thick, patchy clay skins on horizontal surfaces of till structure.

Location of profile: Lincoln County, Minn.; Sec. 33, T. 111 N., R. 44 W.; 0.1 mile S. of the NW. corner.

Singsaas loam, gently undulating (3 to 4 percent slopes) (So; subgroup 2C).—This soils occurs on gently undulating ground moraine in broad association with the Oak Lake soils, which are on the level and nearly level upland flats and in the slightly depressed colluvial and alluvial upland drainageways. These drainageways are young and poorly formed. They are connecting channels between the depressions in which the Oldham and Parnell soils occur. Singsaas loam, gently undulating, occurs in soil area 50.

Singsaas loam, undulating (5 to 8 percent slopes) (Se; subgroup 3B).—This soil occurs on undulating ground moraine, either as the topographic matrix or as isolated more sloping positions in a gently undulating matrix. It has about the same topographic relations with Oak Lake, Oldham, and Parnell soils as Singsaas loam, gently undulating. It differs from Singsaas loam, gently undulating, in that it has developed in undulating rather than gently undulating positions. It occurs in soil area 50.

Singsaas-Buse loams, gently undulating (3 to 4 percent slopes) (Sg; subgroup 5A).—This unit is a complex of Singsaas and Buse loams on gently undulating slopes. Both soils have developed in loam-clay loam glacial till. The Singsaas soil occurs on nearly level and gently sloping areas. These areas include the short, slightly steeper slopes on which the Buse soil occurs. The Singsaas soil is well drained and completely worm worked; the thin Buse soil is somewhat excessively drained and somewhat worm worked.

This complex occurs on the convex slopes in broad association with the Oak Lake soils, which occur in the uplands in slightly depressed, concave drainageways of colluvium and alluvium. These drainageways are connecting channels between the depressions in which the Oldham and Parnell soils occur. This complex consists of about 75 percent Singsaas soil and 25 percent Buse soil. It occurs in soil areas 50 and 51.

Singsaas-Buse loams, undulating (5 to 8 percent slopes) (Sh; subgroup 5B).—This unit is a complex of Singsaas loam, undulating, and Buse loam, undulating. Both soils have developed in loam-clay loam glacial till. The Singsaas soil occurs as the undulating matrix, and the Buse soil occurs on the sharper breaking, eroded side slopes. The Singsaas soil is well drained and completely worm worked; the Buse soil is thin, somewhat excessively drained, and somewhat worm worked.

This complex, like Singsaas-Buse loams, gently undulating, occurs in broad association with the Oak Lake soils. It is composed of about 70 percent Singsaas soil and 30 percent Buse soil. It occurs in soil areas 50 and 51.

Singsaas-Buse-Pierce loams, undulating (5 to 8 percent slopes) (Sk; subgroup 5B).—This unit is a complex of Singsaas, Buse, and Pierce loams on undulating relief. The Singsaas and Buse soils have developed in loam-clay loam glacial till; the Pierce soil has developed in pockets of mixed sandy and gravelly ice-contact-stratified drift. The Singsaas soil occurs on undulating areas that include sharper breaking, eroded side slopes occupied by the Buse soil. The Pierce soil occurs as pockets in the Buse soil.

The Singsaas soil is well drained and completely worm worked. The Buse soil is thin, somewhat excessively drained, and somewhat worm worked. The Pierce soil is very shallow and excessively drained.

This complex has the same association with the Oak Lake, Oldham, and Parnell soils as Singsaas-Buse loam, gently undulating. It consists of 65 percent Singsaas

soil, 20 percent Buse soil, and 15 percent Pierce soil. It occurs in soil areas 50 and 51.

Singsaas-Buse-Pierce loams, rolling (9 to 18 percent slopes) (Sm; subgroup 5C).—This unit is a complex of Singsaas, Buse, and Pierce soils on rolling relief. The Singsaas and Buse soils have developed in loam-clay loam glacial till, and the Pierce soil has developed in pockets of mixed sandy and gravelly stratified drift. The Singsaas soil occurs on the smoother ridgetops and more gentle slopes, and the Buse soil occurs extensively on the sharply breaking, eroded side slopes. Pierce loam, rolling, occurs as pockets in the Buse soil.

The Singsaas soil is well drained and completely worm worked. The Buse soil is thin, somewhat excessively drained, and somewhat worm worked. The Pierce soil is very shallow and excessively drained.

Except that it occurs on much stronger relief, this complex has the same association with the Oak Lake, Oldham, and Parnell soils as Singsaas-Buse loams, undulating, and Singsaas-Buse-Pierce loams, undulating. It consists of about 50 percent Singsaas soil, 25 percent Buse soil, and 25 percent Pierce soil. It occurs in soil area 51.

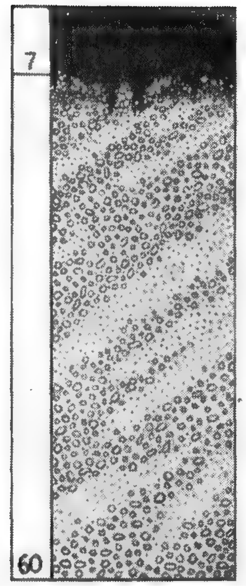

Figure 40.—Sioux loam.

Sioux series

Sioux gravelly loam, gently undulating, is the only Sioux soil mapped in Brookings County. It is an excessively drained Regosol that has developed under mixed mid and short grasses in shallow deposits of medium-textured glacial alluvium. The alluvium overlies glacial outwash of sand and gravel.

The Sioux soils have a black, friable, noncalcareous, granular loam A_1 horizon over a multicolored, strongly calcareous, loose sand and gravel D_{ca} horizon.

The Sioux soils are broadly associated with the Renshaw and Fordville soils. Normally they have profiles that are more shallow than those of the Renshaw and Fordville soils, but soils of these three series are not separated on the basis of depth of profile. They are separated on morphology, as it affects the profile formula. The shallow Sioux soils have an A-D_{ca}-D or A-D-D_{ca} profile; the moderately deep Renshaw soils have an A-B-D_{ca}-D profile; and the deeper Fordville soils have an A-B-C-D_{ca} or an A-B-C_{ca}-D profile.

Many areas of the Sioux soil in Brookings County are in small grains, but many other areas are left in grass and used for pasture or hay.

The following is a profile description of Sioux loam (fig. 40):

A_{1p} 0 to 7 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, dry) and black (10YR 2/1, moist), friable, noncalcareous loam; cloddy to weak fine granular structure; lower boundary abrupt and smooth.

D_{ca} 7 inches +, multicolored but basically grayish-brown (2.5Y 5/2, dry) sand and gravel outwash; contains slight amount of lime segregated as crusts on gravel; loose; strongly calcareous; auger will not go through gravel below 7 inches.

Location of profile: Sec. 12, T. 109 N., R. 50 W.; 100 feet W. and 50 feet S. of N. ¼corner.

Sioux gravelly loam, gently undulating (1 to 4 percent slopes) (Sn; subgroup 6E).—This soil does not occur in a set pattern with the associated Fordville and Renshaw soils. It occurs on gently undulating stream terraces and outwash plains and on the gently sloping fringes and subdued escarpments of the nearly level terraces and outwash plains on which the Fordville and Renshaw soils occur. This unit is in soil area 21.

Solomon series

Solomon clay, nearly level, is the only Solomon soil mapped in Brookings County. It is a poorly drained Humic Gley that has developed under mixed tall grass and sedge associations in 42 inches or more of fine-textured alluvium. The alluvium overlies mixed

Figure 41.—Solomon soil in bottom land of Big Sioux River.

sand and gravel or gravelly glaciofluvial material. The soil occurs on flats or in slightly depressed bottom lands (fig. 41). It occurs in somewhat lower and more concave positions in the alluvial landscape than the associated Lamoure soil.

The Solomon soils have a black, moderately calcareous clay A_1 horizon that overlies a B_{2g} horizon of calcareous clay of weak prismatic structure. The C_{gca} horizon of mottled, olive-gray, strongly calcareous clay overlies the D_g horizon of olive-gray, moderately calcareous, mixed sandy and gravelly outwash or glaciofluvial materials.

The Solomon soil is rather closely associated with the Lamoure, Volga, and Rauville soils, but these soils differ from the Solomon. The Lamoure soil has developed in less fine-textured alluvium and is somewhat poorly drained. The Volga soils have gravel at depths of less than 42 inches. The Rauville soils are very poorly drained.

Most areas of Solomon soils are not cultivated.

The following is a profile description of Solomon clay (fig. 42):

A_0-A_1 0 to 1 inch, black (2/0, dry and moist) peaty layer mixed with clay that is on the silty clay boundary; very friable; moderately calcareous; weak fine granular structure; lower boundary clear and smooth.

A_1 1 to 7 inches, black (2/0, dry and moist), friable, moderately calcareous clay; weak fine granular structure; lower boundary clear but irregular.

B_{2g1} 7 to 14 inches, dark-gray and gray (4/0 and 6/0, dry) to very dark gray (3/0, moist), friable to firm, strongly calcareous clay; weak coarse prismatic structure that breaks to moderate fine and medium granular; lower boundary irregular.

B_{2g2} 14 to 22 inches, dark-gray (4.5/0, dry) to very dark grayish-brown (1.25Y 3.5/2, moist), friable to firm, strongly calcareous clay; weak coarse prismatic structure that breaks to moderate fine and medium granular; lower boundary clear but irregular.

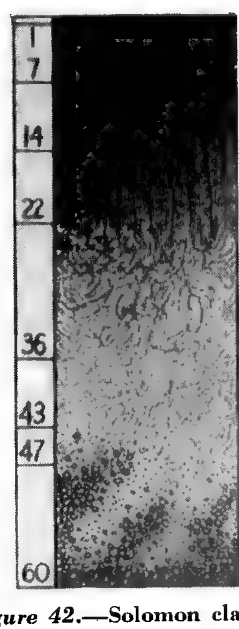

Figure 42.—Solomon clay.

C_{gca1} 22 to 36 inches, light-gray and white (5.5/0 and 8/0, dry) to olive-gray and white (5Y 4.5/2 and 8/0, moist) clay; segregated lime common; friable to firm; strongly calcareous; massive structure; lower boundary smooth.

C_{gca2} 36 to 43 inches, light-gray and white (5Y 6/1.5 and 8/0, dry) to olive-gray and white (5Y 5/2 and 8/0, moist) loam with a few segregations of lime; friable to firm; strongly calcareous; massive structure.

C_{gca2}-D_g 43 to 47 inches, transition.

D_g 47 to 60 inches, gray (5.5/0, dry) to olive-gray (5Y 4/2, moist), outwash of loose sandy loam texture; moderately calcareous; massive and single-grain structure.

Location of profile: Sec. 29, T. 110 N., R. 50 W., SE. corner.

Solomon clay, nearly level (0 to 2 percent slopes) (So; subgroup 8C).—This soil has the same relation with its associated soils as Lamoure silty clay loam, nearly level. It is less suitable for cultivation than the Lamoure soil. It occurs in soil area 10.

Terrace escarpments, sloping

Terrace escarpments, sloping (Ta; subgroup 6E).—This mapping unit is generally composed of undifferentiated Sioux and Renshaw soils that occur primarily on sloping to steep terrace escarpments. This land type occurs primarily in soil areas 20 and 21.

Tetonka series

Tetonka silty clay loam, nearly level, is the only soil of the Tetonka series mapped in Brookings County. It is a somewhat poorly and poorly drained Soloth that has developed under tall grass and sedge associations in glacial till, and in various depths of local alluvium over glacial till. The soil occurs in shallow swales and depressions of various size that normally have slightly different relief than the surrounding associated Ahnberg and Poinsett soils.

The Tetonka soils have a black, friable A_1 horizon that overlies a rather thick A_2 horizon that is light gray to white, friable, and of platy structure. The B_2 horizon is black, firm, and of prismatic and blocky structure. This layer is of a type characteristic of the B horizon of Solonetz soils. A mottled, firm B_3 horizon of blocky structure overlies a mottled, friable to firm C_{ca} horizon. Some variation in depth and thickness of the A_1 and A_2 horizons occurs in these soils.

Most areas of these soils are too wet to cultivate, but in dry years the less poorly drained areas are cropped to corn or small grains.

The following is a representative profile of Tetonka silt loam (fig. 43):

A_1 0 to 9 inches, dark gray or very dark gray (10YR 4/1 or 3/1, dry) and black (10YR 2/1, moist), neutral to slightly acid silt loam; weak to moderate granular and crumb structure that grades into platy structure in lower part of horizon; soft to slightly hard when dry, and very friable when moist; lower boundary abrupt.

A_2 9 to 15 inches, white, light-gray, or gray with few to many fine mottles of strong brown (10YR 8/1 to 6/1

Figure 43.—Tetonka silt loam.

with 7.5YR 5/6, dry), and light-gray to gray mottled with dark brown (10YR 7/1 to 5/1 with 7.5YR 4/4, moist) silt loam; slightly acid or neutral; well-defined medium and fine platy structure with numerous vesicles; soft when dry, very friable when moist; lower boundary abrupt.

B_2 15 to 30 inches, dark-gray to very dark grayish-brown (10YR 4/1 to 3/2, dry) and black to very dark brown (2/1 to 2/2, moist) silty clay loam to silty clay; slightly acid or neutral; moderate to strong fine compound structure, grading with depth to coarse prismatic and blocky; aggregates have a thick colloidal coating; extremely hard when dry, very firm when moist; grades into horizon below.

B_3 30 to 48 inches, light yellowish-brown to gray, or mottlings of these colors, and light olive-brown (2.5Y 6/4 to 6/2 with 5/6, dry) and light olive-brown to gray mottled with olive brown (5/4 to 5/2 with 4/4, moist) silty clay loam or clay loam; slightly acid to neutral; weak to moderate blocky structure; extremely hard when dry, very firm when moist; aggregates have a thick colloidal coating.

C_{ca} 48 to 60 inches, silt loam, loam, or clay loam, of the same colors as in horizon above or ranging to pale yellow mottled with olive yellow and white (2.5Y 6/4 to 6/2, or 5Y 8/3 with 6/8 and 8/1, dry) and pale olive, mottled with olive and light gray (2.5Y 5/4 to 5/2 or 5Y 6/3 with 5/6 and 7/1, moist); contains segregated lime with or without the soil mass being calcareous; massive structure; hard to very hard when dry, friable to firm when moist.

Tetonka silty clay loam, nearly level (0 to 2 percent slopes) (Tb; subgroup 8B).—This soil occurs in shallow swales and depressions in rather close association with the Waubay soils. In their association with this soil, the Waubay soils occur in the young drainageways and connecting channels between the more clearly defined and usually larger depressions of the Oldham and Parnell soils. Tetonka silty clay loam, nearly level, generally occurs only in areas of Ahnberg-Poinsett complex, gently undulating, and Ahnberg-Poinsett complex, undulating, but it is also in isolated places in other parts of the county. This unit is included with the Oldham and Parnell soils in soil area 60.

Vienna series

The Vienna soils in Brookings County are well drained. They are members of the catena that also includes the moderately well drained Lismore soils and the somewhat poorly drained Leota soils. They have developed under tall and mid grass associations in glacial till of Iowan and Tazewell age. This glacial till is of loam or clay loam texture, or both.

The Vienna soils vary considerably in relief, depending on the drift sheet on which they occur. On the Iowan drift they have only slight differences in local relief; on the Tazewell drift they have stronger differences.

On the Iowan drift, the Vienna soils are somewhat homogeneous and occur on the convex, nearly level and gentle slopes of the gently undulating ground moraine. In these positions, Vienna soils occur in broad association with the Lismore soils. The Lismore soils have developed on the level to nearly level upland flats, on broad expanses of ground moraine, and in the slightly impressed, concave upland drainageways of colluvium and alluvium in the well-developed dendritic drainage pattern. The Leota soils occur in the more poorly drained parts of this drainage pattern.

Figure 44.—Vienna soils. Note landscape with integrated drainage.

On the Tazewell drift, the Vienna soils are less homogeneous and occur on the convex, nearly level or gently sloping positions of the undulating ground moraine (fig. 44). In these positions they occur in broad association with the Buse soils, and in some places on the eroded stronger slopes with the Buse and Pierce soils. Vienna soils also occur in broad association with the Lismore soils on the Tazewell drift. Here the Lismore soils have developed on the level to nearly level upland flats and on broad ridgetops, and in the rather deeply impressed, concave, upland drainageways of colluvium and alluvium in the well-drained dendritic pattern. As on the Iowan drift, the Leota soils occur in the more poorly drained parts of this drainage pattern.

Based on profile characteristics, two kinds of Vienna soil occur in Brookings County. These different profiles can be correlated with the drift sheet on which they occur. The Iowan drift has little local relief, predominantly loam textures, and a homogeneous com-

position. The Tazewell drift has fairly strong local relief, predominantly clay loam textures, and a stony, somewhat more heterogeneous composition. The Vienna soils that developed on the two different kinds of drift are described separately in the profiles that follow.

Profile A (fig. 45) is representative of Vienna loam developed on Iowan drift, and it is considered modal Vienna soil for the county.

A_{1p} 0 to 8 inches, very dark gray (10YR 3/1, dry) to black (10YR 2/1, moist), friable, noncalcareous loam; cloddy to moderate coarse granular structure.

B_{21} 8 to 13 inches, very dark gray and grayish-brown (10YR 3/1 and 2.5Y 5/2, dry) to black and dark grayish-brown (2/0 and 2.5Y 4/3, moist) noncalcareous loam; very weak medium prismatic structure that breaks to moderate medium blocky; some mixing of A and B; thin, continuous clay skins on peds.

B_{22} 13 to 18 inches, grayish-brown (2.5Y 5/2.5, dry) to dark grayish-brown (2.5Y 4/3, moist) noncalcareous loam; very weak medium prismatic structure that breaks to moderate medium blocky; thin, continuous clay skins on peds.

C_{ca} 18 to 40 inches, pale-yellow (2.5Y 7/3, dry) to grayish-brown (2.5Y 5/3, moist) strongly calcareous clay loam; segregations of lime are common; very weak medium prismatic to massive structure.

C 40 to 60 inches, light yellowish-brown, white, and yellowish-brown (2.5Y 6/3, 7/0, and 10YR 5/8, dry) to grayish-brown, white, and yellowish-brown (2.5Y 5/2.5, 6/0, and 10YR 5/8, moist) loam glacial till, on the clay loam boundary; contains a few lime segregations; moderately calcareous; massive structure.

Location of profile: Sec. 18, T. 110 N., R. 49 W.; 145 feet N. and 60 feet W. of center of section.

The following is a representative profile of Vienna loam (profile B) that developed on the Tazewell drift.

A_{1p} 0 to 6 inches, very dark grayish-brown (1Y 3.5/2, dry) to black (10YR 2/1, moist), very friable, noncalcareous loam; weak fine crumb structure; lower boundary clear and smooth.

AB 6 to 11 inches, dark grayish-brown (10YR 4/2, dry) to very dark grayish-brown (10YR 3/2, moist), friable, noncalcareous clay loam; weak moderate and coarse prismatic structure that breaks to weak fine granular; thin, patchy clay skins on faces of peds; lower boundary clear but irregular.

B_2 11 to 20 inches, grayish-brown (1Y 5/2.5, dry) to dark grayish-brown (1Y 4/2.5, moist), friable, noncalcareous clay loam; weak medium and coarse prismatic structure that breaks to moderate medium blocky and, in turn, to moderate fine granular; thin, continuous clay skins on faces of peds; lower boundary clear but irregular.

B_{3ca} 20 to 28 inches, light brownish-gray and white (2.5Y 6/2.5 and 8/0, dry) to light olive-brown and white (2.5Y 5/3.5 and 8/2, moist), friable, strongly calcareous loam; lime segregations are common; weak medium and coarse prismatic structure that breaks to weak fine granular; thin, continuous clay skins on peds; lower boundary irregular.

C_{ca} 28 to 46 inches, light-gray and white (2.5Y 7/3 and 8/0, dry) to light olive-brown and white (2.5Y 5/3.5 and 8/2, moist), friable, strongly calcareous loam glacial till; contains a few lime segregations; massive to weak fine and medium horizontal blocky structure.

C 46 to 60 inches, light brownish-gray and white (2.5Y 6/2.5 and 8/0, dry) to light olive-brown and white (2.5Y 5/3.5 and 8/0, moist), friable, moderately calcareous loam glacial till; contains a few lime segregations; moderate fine and medium horizontal blocky structure.

Location of profile: Sec. 25, T. 112 N., R. 49 W.; 0.15 mile N. of E. ¼ corner.

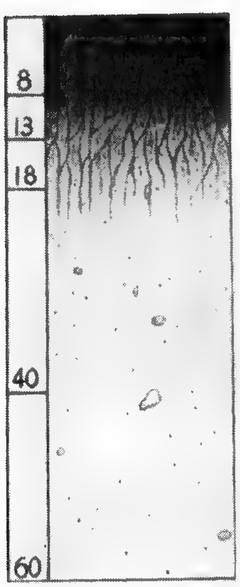

***Figure 45.*—Vienna loam (profile A).**

The modal Vienna soil of Brookings County represented by profile A differs from the soils of the Vienna series as mapped in other counties primarily in its lighter texture, thinner A horizon, noncalcareous B horizon that shows clay-skin development and yellower hue, and in its parent material of massive loam till instead of structured clay loam till. The Vienna soil of Brookings County represented by profile B, although not considered modal for the county, is more nearly like the soils of the Vienna series as mapped in other counties. It differs from them, however, primarily in having B horizons that show clay-skin development and a yellower hue.

Almost all of the acreage of Vienna soils is used for corn, small grains, and alfalfa.

Vienna loam, nearly level (0 to 2 percent slopes) (Va; subgroup 2A).—This soil has developed in glacial till of Iowan and Tazewell age. The till is of loam or clay loam texture, or both. This unit is in soil area 31.

This soil occurs primarily on the Iowan drift plain, where it has a profile similar to profile A. On this plain it occurs on the convex, nearly level positions in the gently undulating landscape. It is broadly associated with Vienna loam, gently sloping, and is in catenal association with the Lismore and Leota soils that occur in the upland drainageways of the well-integrated drainage pattern.

Where this soil occurs on the Tazewell drift plain, it has a profile similar to profile B, and it occupies convex, nearly level ridgetops in the undulating landscape. On this plain it is broadly associated with Vienna loam, sloping; Vienna loam, gently sloping; Vienna-Buse loams, gently undulating; and, in places, Vienna-Buse loams, undulating. It also occurs in catenal association with the Lismore and Leota soils.

Vienna loam, gently sloping (3 to 4 percent slopes) (Vb; subgroup 2B).—This soil has developed in glacial till that is of loam or clay loam texture, or both. It occurs on both the Iowan and the Tazewell drift plains. It is in soil area 31.

On the Tazewell drift plain, this soil has a profile similar to profile B. Here it occurs on gently sloping ridgetops and on gentle slopes at the heads of drains in broad association with Vienna loam, sloping; Vienna loam, nearly level; Vienna-Buse loams, gently undulating; Vienna-Buse loams, undulating; and in places Vienna-Buse-Pierce loams, undulating. It also occurs in catenal association with the Lismore and Leota soils.

On the Iowan drift plain, Vienna loam, gently sloping, has a profile similar to profile A and occurs on gentle slopes that descend to the drains. In these positions it is in association with Vienna loam, nearly level, and, in places, with Vienna loam, sloping. The soil is also in catenal association with the Lismore and Leota soils that occur in the upland drainageways of the well-integrated drainage pattern.

Vienna loam, sloping (5 to 8 percent slopes) (Vc; subgroup 3A).—This soil has developed in glacial till that is of loam or clay loam texture, or both. It occurs on both the Iowan and Tazewell drift plains and is in soil area 31.

On the Tazewell drift plain, Vienna loam, sloping, has a profile similar to profile B. It occurs on the long uneroded slopes of hills in broad association with Vienna loam, gently undulating; Vienna loam, nearly level; Vienna-Buse loams, gently undulating; Vienna-Buse loams, undulating; and, in places, Vienna-Buse-Pierce loams, undulating. It is also in catenal association with the Lismore and Leota soils that occur in the upland drainageways of the well-integrated drainage pattern.

On the Iowan drift plain, Vienna loam, sloping, has a profile similar to profile A. It occurs primarily on the side slopes along the larger stems of the dendritic drainage pattern, where it is broadly associated with Vienna loam, nearly level; Vienna loam, gently sloping; and, in places, Vienna-Buse loams, gently undulating, and Vienna-Buse loams, undulating. It is also associated with the Lismore and Leota soils.

Vienna-Buse loams, gently undulating (3 to 4 percent slopes) (Vg; subgroup 5A).—This is a complex of Vienna loam, gently undulating, and Buse loam, gently undulating. The Vienna-Buse and the Vienna-Buse-Pierce complexes occur primarily on the Tazewell drift plain. The Vienna soil is well drained. It has developed in loam-clay loam glacial till of Iowan and Tazewell age, but in this complex it has developed primarily in till of Tazewell age. It occurs on the somewhat smoother, less eroded positions on the gently undulating landscape and has a profile similar to profile B. In this complex Buse loam, gently undulating, is somewhat excessively drained. It has developed in loam-clay loam glacial till on the shorter and somewhat steeper eroded slopes and low knobs of the gently undulating landscape.

This complex occurs in broad association with the other Vienna-Buse and Vienna-Buse-Pierce complexes and in catenal association with the Lismore and Leota soils that occur in the upland drainageways of the well-integrated drainage pattern. The complex is composed of about 75 percent Vienna soil and 25 percent Buse soil. It occurs in soil area 31.

Vienna-Buse loams, undulating (5 to 8 percent slopes) (Vh; subgroup 5B).—This is a complex of Vienna loam, undulating, and Buse loam, undulating.

The well-drained Vienna loam, undulating, has developed in loam-clay loam glacial till of both Iowan and Tazewell age, but in this unit it has developed primarily in till of Tazewell age. It occurs on the somewhat smoother, less eroded positions of the undulating landscape and has a profile similar to profile B. In this complex Buse loam, undulating, is somewhat excessively drained. It has developed in loam-clay loam glacial till on the shorter, steeper eroded slopes and low knobs of the gently undulating landscape.

This complex is broadly associated with the other Vienna-Buse and Vienna-Buse-Pierce complexes. It is also in catenal association with the Lismore and Leota soils that occur in the upland drainageways of the well-integrated drainage pattern. The complex consists of about 70 percent Vienna soil and 30 percent Buse soil. It is in soil area 31.

Vienna-Buse loams, steep (9 to 18 percent slopes) (Vk; subgroup 5C).—This unit is a complex of the Vienna loam, steep, and Buse loam, steep. The complex occurs on steep slopes in an undulating landscape. The well-drained Vienna loam, steep, has developed in loam-clay loam glacial till of both Iowan and Tazewell age, but in this unit it has developed primarily in till of Tazewell age. It has a profile similar to profile B and occurs in complex with Buse loam, steep, on the steep, breakaway slopes that extend down from the smoother ground moraine positions. It normally occurs in the sheltered, less eroded positions on the slope.

Buse loam, steep, is somewhat excessively drained. It has developed in loam-clay loam glacial till and occurs on the eroded knobs, ridge lines, and other exposed steep positions on the breakaway slopes.

This complex occurs in broad association with the other Vienna-Buse and Vienna-Buse-Pierce complexes. It is in catenal association with the Lismore and Leota soils that occur in the upland drainageways of the well-integrated drainage pattern. The complex is about 50 percent Vienna soil and 50 percent Buse soil. It occurs primarily in soil area 70.

Vienna-Buse-Pierce loams, undulating (5 to 8 percent slopes) (Vm; subgroup 5B).—This unit is a complex of Vienna loam, undulating; Buse loam, undulating; and Pierce loam, undulating. It occurs on an eroded morainic landscape. The well-drained Vienna loam, undulating, has developed in loam-clay loam glacial till of Iowan and Tazewell age but in this complex it has developed primarily in till of Tazewell age. It has a profile similar to profile B. Vienna loam, undulating, predominates in the complex on the smoother, less sloping, and less eroded crests of the undulating landscape.

In this complex Buse loam, undulating, is thin and somewhat excessively drained. It has developed in loam-clay loam glacial till and occurs on the short,

steep eroded side slopes, knobs, and ridges in the undulating landscape.

In this complex Pierce loam, undulating, is very shallow and excessively drained. It has developed in pockets of mixed sandy and gravelly stratified drift. The soil is very closely associated with the Buse loam, undulating, and occurs as pockets intermingled with it.

This complex occurs in broad association with the other Vienna-Buse and Vienna-Buse-Pierce complexes and in catenal association with the Lismore and Leota soils that occur in the upland drainageways of the well-integrated drainage pattern. The complex consists of about 65 percent Vienna soil, 20 percent Buse soil, and 15 percent Pierce soil. It occurs primarily in soil area 31.

Vienna-Buse-Pierce loams, rolling (9 to 18 percent slopes) (Vn; subgroup 5C).—This unit is a complex of Vienna loam, rolling; Buse loam, rolling; and Pierce loam, rolling. It occurs on an eroded, morainic landscape. The well-drained Vienna loam, rolling, has developed in loam-clay loam glacial till of Iowan and Tazewell age, but in this unit it occurs primarily in till of Tazewell age. It has a profile similar to profile B. It is the predominant member of the complex on the smoother, less rolling, and less eroded hill crests in the rolling landscape.

In this complex Buse loam, rolling, is thin and somewhat excessively drained. It has developed in loam-clay loam glacial till and occurs on the steep eroded side slopes, knobs, and ridge keels in the rolling landscape.

Pierce loam, rolling, is very shallow and excessively drained. It has developed in pockets of mixed sandy and gravelly stratified drift. In this complex Pierce loam, rolling, is very closely associated with Buse loam, rolling, and occurs as pockets intermingled with it.

This complex occurs in broad association with the other Vienna-Buse and Vienna-Buse-Pierce complexes and in catenal association with the Lismore and Leota soils that are in the upland drainageways of the integrated drainage pattern. It consists of about 50 percent Vienna soil, 25 percent Buse soil, and 25 percent Pierce soils. It occurs primarily in soil area 70.

Vienna sandy loam, gently undulating (3 to 4 percent slopes) (Vd; subgroup 7c).—This well-drained soil has developed in a very thin or thin windblown mantle of sand that affects only the A horizon over the loam-clay loam glacial till. The soil occurs on both the Iowan and Tazewell drift plains. It is on gently undulating upland strips that are adjacent to major drainageways, as well as on a series of ridgetops that run perpendicular to the dendritic drainage pattern of the Tazewell drift plain. This soil is in rather close association with Vienna sandy loam, undulating, and in broad association with the Dickey, Maddock, and other Vienna soils. It occurs primarily in soil area 31.

Vienna sandy loam, undulating (5 to 8 percent slopes) (Ve; subgroup 7e).—This soil is similar to Vienna sandy loam, gently undulating, except that it occurs in steeper slopes. It is primarily in soil area 31.

Volga series

The Volga soils in Brookings County are somewhat poorly and poorly drained Humic Gleys of the bottom lands. They have developed under mixed tall grass and sedge associations in less than 42 inches of medium textured and moderately fine textured alluvium, which overlies mixed sand and gravel or gravelly glaciofluvial materials. Volga soils occur on nearly level, broad bottom lands and on somewhat lower, slightly concave alluvial flats. In some places they are on shallow, narrow, dendritic drains that extend far back into the upland.

The Volga soils have a black, very weakly calcareous, silty clay loam A_1 horizon. The C_{gca} horizon is strongly mottled, gleyed, moderately calcareous clay loam. A mottled, strongly gleyed, noncalcareous G horizon overlies D_{gca} or D_g horizons of loose sand and gravel. Drainage phases of nearly level Volga silty clay loam and Volga loam are mapped in Brookings County.

The Volga soils are rather closely associated with the Solomon, Lamoure, and Rauville soils. They differ from the Solomon soils in that they are less fine textured and less than 42 inches deep to the gravelly substratum. The Lamoure soils differ from the Volga in being deeper than 42 inches to the gravel, and the Rauville soils differ from the Volga in being very poorly drained.

Many of the somewhat poorly drained areas of Volga soils are cultivated mainly to corn and small grains. The poorly drained areas are generally left in grass, which is used as pasture or hay.

The following is a representative profile of Volga silty clay loam (fig. 46):

A_{1p} 0 to 5 inches, black (1Y 2/1, dry and moist), firm, very weakly calcareous, heavy silty clay loam; cloddy structure; has a false boundary with horizon below.

A_1 5 to 12 inches, black (1Y 2/1, dry and moist), firm, very weakly calcareous, light silty clay; very

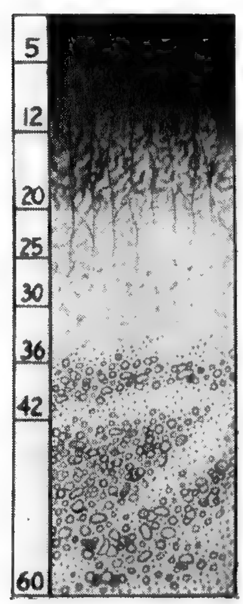

Figure 46.—**Volga silty clay loam.**

weak coarse prismatic to cloddy structure; lower boundary irregular.

A_g-C_g 12 to 20 inches, black indistinctly mottled with dark gray (2.5Y 2/1, and 4/0.5, dry) and black indistinctly mottled with very dark gray to very dark grayish brown (1Y 2/1, and 2.5Y 3/1, moist) light silty clay; friable to firm; weakly calcareous; weak coarse prismatic structure; thin, patchy clay skins on faces of peds; lower boundary clear but irregular.

C_{gca} 20 to 25 inches, dark-gray indistinctly mottled with gray and white (5Y 4/1, 6/1, and 8/1, dry) and very dark gray, pale-olive, and white (5Y 3/1, 6/3, and 8/1, moist) clay loam; contains a few, small, soft segregations of lime; friable to firm; moderately calcareous; weak medium prismatic structure; thin, very patchy clay skins on faces of peds; lower boundary clear but irregular.

G 25 to 30 inches, olive-gray indistinctly mottled with white and light brownish gray to light yellowish brown (5Y 5/2, 8/1, and 2.5Y 6/3, dry), and gray, white, and light brownish-gray (5Y 5/1, 8/1 and 2.5Y 6/2, moist) clay loam; small, soft segregations of lime are common; firm; massive structure; lower boundary smooth.

D_{gca} 30 to 36 inches, grayish-brown indistinctly mottled with light brownish gray and olive yellow (2.5Y 5/2, 6/2, and 6/6, dry) and dark grayish-brown to olive-brown, grayish-brown, and light olive-brown (2.5Y 4.5/3, 5/2 and 5/4, moist) sandy clay loam; contains a few, small, soft segregations of lime; loose; moderately calcareous.

D_{g1} 36 to 42 inches, multicolored mixed sands and gravel; basic colors light brownish gray to light yellowish brown (2.5Y 6/3, dry) and grayish brown to light olive brown (2.5Y 5/3, moist); loose; weakly calcareous; dirty.

D_{g2} 42 to 60 inches, multicolored mixed sands and gravels; basic colors grayish brown (2.5Y 5/2, dry) and dark grayish brown (2.5Y 4/2, moist); loose; very weakly calcareous; dirty.

Location of profile: Sec. 19, T. 110 N., R. 50 W.; 0.25 mile W. and 25 feet S. of NE. corner.

Volga silty clay loam, somewhat poorly drained, nearly level (0 to 2 percent slopes) (Vp; subgroup 8A).—This soil has developed in moderately fine textured alluvium. It occurs primarily on nearly level, broad bottom lands, but some areas are in shallow, narrow, dendritic drains that extend far back into the uplands.

The soil is associated with Volga silty clay loam, poorly drained, nearly level, but it occurs in somewhat higher and less concave positions in the alluvial landscape than the poorly drained soil and is more suitable for cultivation. It is in soil area 11.

Volga loam, somewhat poorly drained, nearly level (0 to 2 percent slopes) (Vo; subgroup 8A).—This bottom-land soil has developed in moderately fine textured alluvium. It differs from Volga silty clay loam, somewhat poorly drained, nearly level, only in having a loam instead of a silty clay loam surface soil. Volga loam, somewhat poorly drained, nearly level, occurs primarily on broad bottom lands and has the same relation with the associated soils as Volga silty clay loam, somewhat poorly drained, nearly level. It occurs in soil area 11.

Volga silty clay loam, poorly drained, nearly level (0 to 2 percent slopes) (Vr; subgroup 8C).—This soil has developed in moderately fine and fine textured alluvium. It occurs on flat or slightly depressed bottom lands and has the same relations with the associated soils as Volga silty clay loam, somewhat poorly drained, nearly level. It differs from Volga silty clay loam, somewhat poorly drained, nearly level, in being poorly drained, somewhat finer textured, and less suitable for cultivation. This unit occurs in soil area 11.

Waubay series

The Waubay soils in Brookings County are moderately well drained Chernozems. They have developed under mixed tall and mid grasses in stratified silty glacial drift of Cary age or in various thicknesses of colluvium and alluvium that mantle the drift. These soils occur on nearly level and level upland flats or in slight swales. They are in catenal association with the Poinsett soils on the more sloping convex positions. They also occur in a pattern of incompletely developed, concave, colluvial-alluvial drains and swales in association with the more poorly drained depressions and marshes. These depressions and marshes interlace the convex positions of the Poinsett soils and the Poinsett-Buse-Pierce soil complexes.

The Waubay soils have a thick, black, granular, silty clay loam A_1 horizon. The B_2 horizon is dark grayish-brown silty clay loam of weak to moderate prismatic and blocky structure. A C_{ca} horizon of olive brown, moderately calcareous, massive silty clay loam overlies slightly mottled C, D_{ca}, or D horizons.

The Waubay soils are the moderately well drained members of the Poinsett, Waubay, Oldham, and Parnell catena. Most areas of these soils are used for corn, small grains, and alfalfa.

The following is a profile description of Waubay silty clay loam (fig. 47):

A_{1p} 0 to 5 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, dry) and black (10YR 2/1, moist), very friable to friable, noncalcareous, light silty clay loam; cloddy to weak fine granular structure; a false boundary with horizon below.

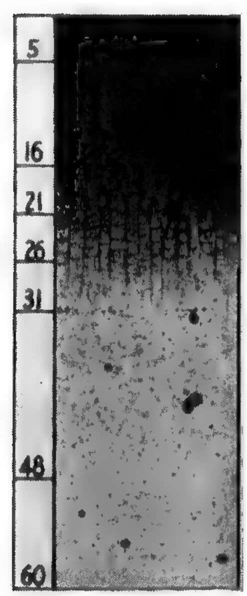

Figure 47.—Waubay silty clay loam.

A_1 5 to 16 inches, dark-gray to dark grayish-brown (10YR 4/1.5, dry) and black to very dark gray (10YR 2.5/1, moist), friable, noncalcareous silty clay; very weak coarse prismatic structure that breaks to cloddy; lower boundary smooth.

B_{21} 16 to 21 inches, dark grayish-brown (10YR 4/2, dry) and very dark grayish-brown (10YR 3/1, moist), friable, noncalcareous silty clay loam; weak to moderate coarse and medium prismatic structure that breaks to weak to moderate medium blocky; thin patchy and thick very patchy clay skins on faces of peds; lower boundary smooth.

B_{22} 21 to 26 inches, grayish-brown to light olive-brown (2.5Y 5/3, dry) and dark grayish-brown to olive-brown (2.5Y 4/3, moist), friable to firm, noncalcareous silty clay loam; weak to moderate medium blocky structure; thin, patchy clay skins on faces of peds; lower boundary smooth.

C_{ca} 26 to 31 inches, grayish-brown to light olive-brown (2.5Y 5/3, dry) and dark grayish-brown to olive-brown (2.5Y 4.5/3, moist), friable to firm, moderately calcareous silty clay loam; contains a small amount of segregated lime; massive structure; lower boundary smooth.

D_{ca} 31 to 48 inches, grayish-brown mottled with yellowish brown (2.5Y 5/2 and 10YR 5/8, dry) and dark grayish-brown and yellowish-brown (2.5Y 4/2 and 10YR 5/8, moist) clay loam glacial till; contains many large and medium, soft segregations of lime; firm; strongly calcareous; massive structure.

D 48 to 60 inches, grayish-brown mottled with yellowish brown (2.5Y 5/2 and 10YR 5/8, dry), and dark grayish-brown to olive-brown and yellowish-brown (2.5Y 4/2.5 and 10YR 5/8, moist) clay loam glacial till; firm; moderately calcareous; massive structure.

Location of profile: Sec. 23, T. 110 N., R. 52 W.; 0.1 mile W. and 200 feet S. of the NE. corner.

Waubay silty clay loam, nearly level (0 to 2 percent slopes) (Wa; subgroup 1A).—This soil has developed in stratified silty drift. It occurs on nearly level and level upland flats or slight swales in broad association with the Poinsett soils on the more sloping convex positions. Except that it has not been affected by colluvium and alluvium, this soil is similar to Waubay silty clay loam, drainageways, which occurs in concave upland drains and swales. It occurs primarily in soil area 40.

Waubay silty clay loam, drainageways (Wb; subgroup 1B).—This soil has developed in stratified silty drift or in shallow or moderately deep colluvial-alluvial deposits over the drift. The soil occurs in catenal association with all the soils of the Poinsett series. It occurs in a pattern of incompletely developed, concave, colluvial-alluvial drains and swales in association with the more poorly drained depressions and marshes that interlace the convex landscape positions of the Poinsett soils and the Poinsett-Buse-Pierce soil complexes. This unit occurs in soil areas 40, 41, 42, and 43.

Mechanical and Chemical Analysis

Data obtained by mechanical and chemical analysis of important soils in Brookings County are given in table 5. The procedures used in this analysis were essentially the same as those given in Agriculture Handbook 60, Diagnosis and Improvement of Saline and Alkali Soils (*5*). The principal departure from the procedures outlined in Handbook 60 was that the organic matter in the following soils was not destroyed before mechanical analysis: Ahnberg silt loam, Estelline silt loam, Fordville sandy loam, Hecla sandy loam, Kranzburg silt loam (profiles A and B), Lamoure silty clay loam, Maddock sandy loam, Oak Lake silt loam, Oldham silty clay loam, Poinsett silt loam, Solomon clay, and Vienna loam (profiles A and B).

Use, Management, and Productivity of Soils[6]

Soil Management Practices

The basic practices for good management that are needed to keep the soil fertile and productive are similar for most soils in Brookings County. However, the intensity of management needed for optimum yields varies on different soils. Some soils have problems of drainage, droughtiness, erosion, and nutrient deficiency that require special attention.

Recommendations for management are subject to change because levels of soil fertility change and because new discoveries are made in fertilizer use, crop varieties, and tillage and cultural practices.

The major practices of good soil management are (1) use of proper crop rotations; (2) maintenance of soil organic matter; (3) restoration of depleted plant nutrients by use of commercial fertilizer; (4) proper tillage methods; (5) moisture conservation and weed control; and (6) erosion control.

Use of crop rotations

A good rotation is the foundation of a sound soil-building program. Such rotations preserve and restore soil structure, restore fertility, and therefore increase soil productivity. A discussion of some of the advantages and limitations of the rotations listed in the yield table (see table 6) follows.

(1) Corn–small grain. This rotation uses soil-depleting crops only, and its continued use will quickly reduce soil fertility and crop yields. Because corn is grown without sod crops, water erosion may cause severe soil losses on steep slopes.

The intertilled crop in this rotation helps to control weeds. The extra cultivations stimulate the breakdown of soil organic matter with the release of available plant nutrients, especially nitrogen. Furthermore, the intertilled crop leaves a reserve of moisture in the soil for the small grain of the following year. In this rotation half the soil is in corn, which usually is the highest paying cash crop.

(2) Corn–small grain, plus fertilizer. In a rotation of corn and small grain, maximum yields will not be obtained unless additional plant food is supplied. Supplemental plant nutrients are provided by commercial fertilizers.

(3) Small grain seeded to sweetclover–corn. In this 2-year rotation sweetclover is plowed under in spring before corn is planted. The amount of rain-

[6] This section was written by F. E. SHUBECK, associate agronomist, and L. F. PUHR, agronomist, South Dakota State College.

fall affects the value of this practice. In years of low rainfall the growth of sweetclover is restricted and the amount of nitrogen and organic matter it adds to the soil is limited.

Weevils often destroy sweetclover stands, but this hazard is lessened by mixing sweetclover with other legumes. As a catch crop, sweetclover uses soil moisture and reduces the amount of water available for the following corn crop. The yield estimates given for this rotation (table 6) are based on the assumption that sweetclover is plowed when 8 to 10 inches high. If it is allowed to grow taller, the moisture reserve is rapidly depleted and yields are reduced.

The fertilizer is applied to the small grain and sweetclover. It is not applied to the corn, because the corn uses the nitrogen added to the soil by the legume. Because the nitrogen released from the soil for a small grain is usually limited, commercial nitrogen is added to the small grain. Phosphorus is especially beneficial to the legume and corn.

(4) Small grain plus red clover or sweetclover–clover for hay or seed–corn. In this rotation the legume is allowed to stand over for one crop year and it may be used for forage or seed. This system returns more nitrogen to the soil than one in which the legume is used as a catch crop, but depletion of subsoil moisture is greater.

(5) Small grain seeded to alfalfa, alfalfa 2 to 4 years–corn–small grain–corn. This rotation is well suited to the more sloping soils, which are subject to erosion. More nitrogen and organic matter are built up in this rotation that uses alfalfa for 2 to 4 years than in rotations that use a catch-crop legume or a 1-year legume. Mixtures of alfalfa and brome may be used in place of pure alfalfa, but reducing the amount of alfalfa in the mixture reduces proportionally the amount of nitrogen returned to the soil. Another advantage of the longer rotation is that weeds are more easily controlled.

The corn following alfalfa may not have enough moisture in years of limited rainfall. In dry years, it may be better to follow alfalfa with a short-season crop such as flax than with a long-season crop such as corn. At the end of the rotation, a good practice is to plow the alfalfa under in midsummer in order to conserve soil moisture for the grain crop of the following year.

The nitrogen for the grain crops is supplied by the legume, and phosphorus is supplied by commercial fertilizer applied to the legume.

Maintenance of soil organic matter

The maintenance of the supply of organic matter by regularly returning it to the soil is a necessary practice in soil management. Organic matter improves the soil by making plant food available and by serving as a storehouse for plant nutrients. It is the only source of soil nitrogen for crops. It improves tilth, increases capacity to absorb and hold water, improves soil structure, and reduces wind and water erosion.

Under ordinary cropping, soil organic matter has been lost at a rate of ½ to 1½ percent per year (*4*). Data taken from experimental plots indicate that the cultivated soils in Brookings County have lost at least 40 percent of their original content of organic matter. Associated with this loss is a loss of nitrogen.

Organic matter may be added to the soil by plowing under crop residues, applying barnyard manure, and using green-manure crops. Rotations that include legumes and grasses help maintain organic matter.

All crop residues should be returned to the soil. Burning straw wastes organic matter. The straw from an acre of oats that yields 40 bushels contains about 16 pounds of nitrogen. Fertilizers increase crop growth and make possible the return of more organic matter to the soil.

Use of commercial fertilizers

Plant-nutrient deficiencies vary with the kind of soil and its cropping history. Soils that have been cropped heavily to small grains and corn are generally more responsive to fertilizer than other soils. The steeply sloping eroded soils are more deficient in nutrients than nearly level, noneroded soils with thick dark A horizons.

Generally, nitrogen is the most deficient element for small grains and corn. On most soils, however, phosphorus is frequently needed for maximum yields and it is especially needed for legumes. Presently commercial potassium is not appreciably needed.

A soil-testing service is maintained at the Agronomy Department of South Dakota State College, where soil samples can be sent to be analyzed and the available nutrient supply determined. Additional information on soil testing and on the use of commercial fertilizers can be obtained from the county agent and from South Dakota State College.

Tillage

One of the most important objectives of tillage is to maintain a surface that allows water to penetrate but resists erosion. Another objective is the eradication of weeds.

It is important to determine the amount of tillage needed. Tillage should be the minimum needed to keep the soil in the best physical condition and to control weeds. Too much cultivation breaks down the structure of the soil, leaves a surface that is easily eroded by water and wind, and increases costs.

Moisture conservation and weed control

Most crops need enormous amounts of water for growth and development. For example, about 550 pounds of water are required to produce a pound of dry matter for oats, and about 800 pounds of water to produce a pound of dry matter for alfalfa. Crop yields depend largely upon how efficiently the rainfall is stored and used and how effectively weeds and runoff are controlled. The value of storing moisture

TABLE 5.—*Mechanical and chemical*

[Unless otherwise designated, analysis

Soil, location, sample and laboratory numbers	Horizon	Depth	Mechanical analysis								
			Particle size distribution in millimeters								
			Very coarse sand (2–1)	Coarse sand (1–0.5)	Medium sand (0.5–0.25)	Fine sand (0.25–0.10)	Very fine sand (0.10–0.05)	Coarse silt (0.05–0.02)	Medium silt (0.02–0.005)	Fine silt (0.005–0.002)	Clay <0.002
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Ahnberg loam *Location:* Sec. 25, T. 110 N., R. 52 W.; 0.45 mi. S. and 500 ft. E. of W. ¼ corner. *Sample No.* 55-SD-6-12; *Lab. No.* 2635-40.	A_{1p}	0–5½	-------	-------	[1]26.4	-------	-------	-------	[2]47.1	-------	26.5
	B_2	5½–16	3.4	8.2	8.0	6.4	7.1	-------	[2]32.7	-------	34.2
	B_{3ca}	16–26	3.8	6.2	6.8	9.0	6.2	-------	[2]34.7	-------	33.2
	C_{ca}	26–33	3.1	7.0	6.9	9.7	8.3	-------	[2]34.5	-------	30.6
	C_1	33–50	3.0	11.6	5.3	9.9	4.8	-------	[2]33.8	-------	31.6
	C_2	50–60	4.5	5.2	11.0	10.1	9.7	-------	31.3	-------	28.3
Athelwold silty clay loam *Location:* Sec. 12, T. 109 N., R. 51 W.; 75 ft. N. and 50 ft. E. of W. ¼ corner. *Sample No.* 55-SD-6-31; *Lab. No.* 1541-46.	A_{1p}	0–6	.2	1.2	2.0	1.8	4.5	-------	[2]60.9	-------	29.4
	AB	6–12	.3	1.1	1.6	1.3	3.7	-------	[2]65.2	-------	26.9
	B_{21}	12–17	.4	1.1	1.1	.8	3.5	-------	[2]62.7	-------	30.4
	B_{22}	17–30	.1	.5	.6	.6	4.4	-------	[2]65.3	-------	28.5
	B_3	30–36	.1	.3	.4	.8	5.7	-------	[2]68.0	-------	24.7
	C	36–54	.2	1.4	2.1	2.0	6.1	-------	[2]64.7	-------	23.5
	D	54–60	9.4	40.2	24.7	11.2	2.6	-------	[2]7.0	-------	4.9
Brookings silty clay loam *Location:* Sec. 14, T. 109 N., R. 48 W.; 60 ft. N. and 120 ft. W. of blazed pole, 0.75 mi. N. of SE. corner. *Sample No.* 55-SD-6-24; *Lab. No.* 1505-1510.	A_{1p}	0–7½	.6	1.3	1.3	1.9	4.2	-------	[2]57.6	-------	33.1
	A_{11}	7½–13	.7	.7	1.1	1.5	6.1	-------	[2]57.6	-------	32.3
	B_2A_1	13–17	.2	1.0	1.0	1.1	4.9	-------	[2]59.5	-------	32.3
	B_2B_{3ca}	17–23	1.3	.5	.7	1.5	10.8	-------	[2]55.5	-------	29.7
	C_{ca}	23–39	.6	1.8	1.1	1.5	11.1	-------	[2]61.8	-------	22.1
	D_{ca}	39–60	3.6	7.6	6.2	7.5	6.7	-------	[2]41.8	-------	26.6
Buse loam *Location:* Sec. 24, T. 112 N., R. 52 W.; 0.2 mi. E. of NW. corner. *Sample No.* 55-SD-6-28; *Lab. No.* 1529-32.	A_{1p}	0–4	5.6	12.0	12.8	9.7	9.5	-------	[2]33.2	-------	17.2
	B_{2ca}	4–20	3.7	4.8	6.8	8.6	10.9	-------	[2]45.4	-------	19.8
	C_{ca}	20–32	2.4	5.4	7.5	17.7	11.9	-------	[2]34.6	-------	22.3
	C	32–42+	2.8	7.2	9.2	10.5	12.9	-------	[2]40.1	-------	17.3
Egeland sandy loam, deep over loamy drift *Location:* Sec. 33, T. 109 N., R. 49 W.; 0.1 mi. S. of NE. corner. *Sample No.* 55-SD-6-21; *Lab. No.* F1484-89.	A_{1p}	0–8½	6.1	15.2	15.9	12.0	6.8	-------	[2]25.3	-------	15.7
	B_1	8½–11	6.0	12.2	15.0	9.8	6.7	-------	[2]34.0	-------	16.3
	B_2	11–16	3.8	19.1	14.5	13.9	8.2	-------	[2]24.5	-------	16.0
	B_3	16–27	8.6	33.5	14.8	14.1	6.4	-------	[2]13.7	-------	8.9
	C_{ca}	27–46	7.5	42.0	19.4	11.8	5.9	-------	[2]7.5	-------	5.9
	$C_{ca}D$	46–53	6.7	30.8	11.1	8.2	8.3	-------	[2]23.8	-------	11.1
Estelline silt loam *Location:* Sec. 25, T. 110 N., R. 49 W.; 100 yds. S. of NW. corner. *Sample No.* 55-SD-6-11; *Lab. No.* 2629-34.	A_{1p}	0–9	.3	1.7	3.1	10.1	3.5	-------	[2]63.4	-------	17.9
	B_{21}	9–17	.6	.8	1.6	4.7	10.9	-------	[2]60.2	-------	21.2
	B_{22}	17–30	.4	1.0	2.9	1.6	14.1	-------	[2]60.9	-------	19.1
	C_{ca}	30–45	.7	.5	1.0	3.4	13.2	-------	[2]63.8	-------	17.4
	CD	45–50	1.4	3.4	9.7	14.1	16.2	-------	[2]40.7	-------	14.6
	D	50–60	2.5	11.1	23.6	28.7	15.7	-------	[2]10.6	-------	7.8
Flandreau loam, deep over till *Location:* Sec. 36, T. 109 N., R. 49 W.; 0.2 mi. S. of NW. corner. *Sample No.* 55-SD-6-22; *Lab. No.* F1490-97.	A_{1p}	0–4	1.2	10.0	9.0	8.5	4.5	-------	[2]45.4	-------	21.4
	A_{11}	4–9	2.2	12.4	6.6	7.1	4.4	-------	[2]53.9	-------	18.6
	B_1	9–14	2.2	11.0	5.0	4.6	3.9	-------	[2]47.3	-------	26.0
	B_{21}	14–22	1.5	5.9	4.9	4.4	2.8	-------	[2]54.5	-------	25.6
	B_{22}	22–27	.6	4.7	4.3	3.6	3.2	-------	[2]57.1	-------	26.5
	B_{23}	27–38	3.4	10.6	5.9	6.6	5.9	-------	[2]44.2	-------	23.5
	D_1	38–54	6.4	21.7	22.0	21.3	8.4	-------	[2]12.1	-------	8.1
	D_{3ca}	54–60	4.5	11.7	8.7	7.4	5.8	-------	[2]31.5	-------	30.9
Fordville sandy loam *Location:* Sec. 1, T. 112 N., R. 52 W.; 0.3 mi. W., 100 ft. S. of NE. corner. *Sample No.* 55-SD-6-5; *Lab. No.* 2493-98.	A_{1p}	0–6	2.2	9.8	17.6	13.2	14.7	4.7	15.0	5.6	17.4
	B_{21}	6–11	1.8	5.3	14.2	17.0	20.4	5.3	12.0	5.5	18.5
	B_{22}	11–19	.9	5.0	20.8	18.5	16.7	3.4	3.0	12.4	19.3
	C	19–28½	1.0	7.4	20.9	19.6	6.0	18.8	5.9	1.9	18.6
	D_1	28½–31	8.8	25.2	28.1	15.0	7.8	2.4	4.2	1.4	7.2
	D_{ca}, D_2	31–60	13.3	45.9	11.3	7.1	10.4	4.0	3.6	.7	3.6

analytical data for important soils
by South Dakota State College]

Textural class	Chemical analysis											
	Cation exchange capacity	Exchangeable cations (milliequivalents per 100 grams)					Electrical conductivity (Ec x 10^3)	PH		CaCo3 equivalent	Organic matter	Nitrogen
		Ca	Mg	Na	K	H		Saturated paste	1:10			
										Percent	*Percent*	*Percent*
Loam	32.64	14.29	11.83	0.24	0.40	--------	0.40	6.5	--------	2.86	3.0	0.2670
Clay loam	34.43	21.81	11.05	.21	.60	--------	.45	6.9	6.8	3.07	1.25	.1268
Clay loam	22.41	(3)	(3)	.19	.49	--------	.50	7.7	7.9	16.25	.60	.0689
Clay loam	23.78	(3)	(3)	.21	.45	--------	.65	7.7	7.9	15.56	.44	.0627
Clay loam	23.10	(3)	(3)	.36	.47	--------	.75	7.8	8.1	17.44	.34	.0548
Clay loam	20.72	(3)	(3)	.33	.45	--------	.85	7.8	8.1	15.94	--------	.0454
Silty clay loam	32.73	17.52	7.80	.12	.66	6.63	.30	6.0	6.9	--------	--------	.2814
Silty clay loam	31.15	16.67	8.75	.12	1.00	4.61	.30	6.2	6.8	--------	--------	.2144
Silty clay loam	33.45	18.05	10.61	.14	.59	4.06	.30	6.3	6.9	--------	--------	.1416
Silty clay loam	32.14	16.41	12.22	.16	.50	2.85	.30	6.3	6.9	--------	--------	.0766
Silt loam	28.59	15.04	10.26	.20	.51	2.58	.40	6.4	6.8	--------	--------	.0558
Silt loam	26.77	15.33	10.68	.22	.54	--------	.37	6.9	7.3	--------	--------	.0498
Gravel	10.38	6.36	3.77	.12	.13	--------	.45	7.7	8.4	--------	--------	.0422
Silty clay loam	38.56	20.68	14.68	.32	.47	2.41	.60	6.5	7.0	--------	--------	.3785
Silty clay loam	37.15	18.62	17.67	.39	.47	--------	.55	7.0	7.3	--------	--------	.3612
Silty clay loam	37.81	16.27	20.71	.36	.47	--------	.55	7.8	8.1	--------	--------	.3064
Silty clay loam	26.49	(3)	(3)	.35	.46	--------	.80	7.9	8.6	--------	--------	.2101
Silt loam	17.80	(3)	(3)	.35	.40	--------	.65	8.1	8.9	--------	--------	.1082
Loam	13.25	(3)	(3)	.38	.40	--------	.70	7.9	9.1	--------	--------	.0327
Loam	18.34	(3)	(3)	.12	.46	--------	.80	7.8	8.6	--------	--------	.1789
Loam	14.95	(3)	(3)	.11	.33	--------	.65	7.7	9.0	--------	--------	.1771
Loam	19.36	(3)	(3)	.20	.44	--------	.60	7.7	9.1	--------	--------	.0354
Loam	13.93	(3)	(3)	.13	.32	--------	.60	7.9	9.1	--------	--------	.0236
Sandy loam	15.90	11.38	4.28	.04	.20	--------	.58	6.2	6.4	--------	--------	.1835
Loam	17.39	12.70	4.41	.08	.20	--------	.90	6.2	6.4	--------	--------	.1308
Sandy loam	16.03	11.42	4.30	.08	.23	--------	.82	6.4	6.5	--------	--------	.0797
Sandy loam	9.41	6.58	2.64	.06	.13	--------	.49	7.0	7.2	--------	--------	.0459
Loamy sand	4.42	(3)	(3)	.03	.12	--------	.54	7.9	8.7	--------	--------	.0334
Sandy loam	8.83	(3)	(3)	.19	.20	--------	.62	7.8	8.9	--------	--------	.0233
Silt loam	32.02	15.29	8.18	.19	.12	--------	.30	6.3	6.5	3.23	7.72	.2770
Silt loam	20.12	13.80	9.91	.25	.25	--------	.40	6.3	6.6	2.86	3.91	.1920
Silt loam	24.72	12.46	10.90	.25	.15	--------	.50	6.6	7.5	3.02	1.58	.0706
Silt loam	19.74	(3)	(3)	.37	.14	--------	.40	7.6	8.7	18.04	.52	.0619
Loam	14.75	(3)	(3)	.35	.15	--------	.45	7.2	8.8	17.44	.32	.0606
Loamy sand	7.57	(3)	(3)	.24	.15	--------	.50	7.5	9.0	11.80	.11	.0502
Loam	27.41	18.28	6.85	.08	.58	1.62	.66	6.5	6.9	--------	--------	.2688
Silt loam	25.76	15.77	6.04	.06	.33	3.56	.79	5.7	6.2	--------	--------	.2087
Loam	27.60	17.22	8.12	.13	.38	1.75	1.07	6.2	6.7	--------	--------	.1515
Silt loam	29.09	18.89	9.68	.11	.41	--------	1.07	7.1	7.5	--------	--------	.1235
Silt loam	31.55	20.83	10.58	.22	.42	--------	.69	7.6	8.0	--------	--------	.1166
Loam	24.99	14.40	10.06	.17	.36	--------	.78	7.9	8.4	--------	--------	.0687
Loamy sand	6.11	(3)	(3)	.11	.15	--------	.80	8.0	8.9	--------	--------	.0358
Clay loam	16.30	(3)	(3)	.20	.37	--------	.68	7.9	8.9	--------	--------	.0249
Sandy loam	19.43	10.02	4.49	.37	.31	--------	.50	6.2	6.4	.92	3.19	.1565
Sandy loam	17.08	9.54	4.58	.70	.32	--------	.40	6.6	6.6	1.04	1.70	.0921
Sandy loam	15.85	10.43	4.38	.75	.23	--------	.35	6.4	7.0	1.04	1.14	.0689
Sandy loam	14.31	8.74	4.55	.59	.18	--------	.60	6.5	6.7	.98	.86	.0574
Loamy sand	8.07	(3)	(3)	.59	.12	--------	.60	7.3	7.4	2.50	.52	.0311
Sand	4.72	(3)	(3)	.58	.11	--------	.40	7.5	8.6	12.13	.15	.0137

TABLE 5.—*Mechanical and chemical analytical*

Soil, location, sample and laboratory numbers	Horizon	Depth	Mechanical analysis: Particle size distribution in millimeters								
			Very coarse sand (2–1)	Coarse sand (1–0.5)	Medium sand (0.5–0.25)	Fine sand (0.25–0.10)	Very fine sand (0.10–0.05)	Coarse silt (0.05–0.02)	Medium silt (0.02–0.005)	Fine silt (0.005–0.002)	Clay <0.002
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Hecla sandy loam	A_{1p}, A_1	0–12	1.5	23.4	30.3	10.1	8.3	2.3	6.3	2.5	15.3
Location: Sec. 32, T. 112 N.,	B_2	12–17	.8	31.3	25.7	15.7	3.4	4.5	5.8	1.2	11.8
R. 50 W.; 270 ft. E., 275	C_1	17–48	.5	35.1	25.3	16.9	8.1	1.0	3.6	.1	9.5
ft. S. of N. ¼corner.	D_1	48–54	----	----	[1] 63.0	----	----	10.9	11.1	1.4	13.9
Sample No. 55-SD-6-1;	D_2	54–60	1.1	10.4	14.0	6.6	13.0	4.6	22.3	5.5	22.6
Lab. No. F2488-92.											
Kranzburg silt loam (E. of	A_{1p}	0–8	.7	2.1	5.0	3.6	6.1	----	[2] 57.9	----	24.6
Big Sioux River)	B_{21}	8–11	.6	2.2	2.5	2.0	9.3	20.5	25.5	10.2	27.3
Location: Sec. 24, T. 111 N.,	B_{22}	11–15	.2	.9	1.1	2.9	8.9	22.3	25.1	8.3	30.3
R. 50 W.; 400 ft. N. of	B_{23}	15–26	.5	1.2	1.8	4.2	8.5	24.3	25.4	7.1	27.0
N. ¼corner.	CD_{ca}, D_{ca}	26–46	3.6	7.7	12.9	6.3	6.8	10.1	18.2	8.2	26.2
Sample No. 55-SD-6-8;	D	46–60	5.6	7.0	5.6	7.0	6.4	11.8	20.1	8.7	27.8
Lab. No. 2611-16.											
Kranzburg silt loam (W. of	A_{1p}	0–5½	.3	2.7	2.9	.8	.7	27.6	35.5	14.5	15.0
Big Sioux River)	B_1	5½–9½	.2	1.2	2.5	1.7	.5	19.5	39.4	19.6	15.5
Location: Sec. 3, T. 112 N.,	B_{21}	9½–14	.3	.5	.7	1.3	1.7	27.7	38.5	12.5	16.8
R. 51 W.; 0.15 mi. E. and	B_{22}	14–30	.2	.6	1.0	1.1	.1	34.3	34.6	11.5	16.6
75 ft. N. of S. ¼corner.	D_{ca}	30–46	1.7	5.8	8.7	7.2	5.7	12.9	21.7	10.2	26.1
Sample No. 55-SD-6-3;	D	46–60	3.2	5.5	4.9	9.1	2.1	----	----	[2] 45.2	30.0
Lab. No. 2507-12.											
Lamoure silty clay loam	A_{1o}	0–1	1.0	.6	3.3	6.5	7.5	----	[2] 54.1	----	27.0
Location: Sec. 21, T. 110 N.,	A_{11}	1–7	.6	.5	4.1	9.2	2.7	----	[2] 58.3	----	24.6
R. 49 W.; 0.35 mi. E. of	B_{2g1}	7–16	.4	.6	1.2	3.7	14.7	----	[2] 55.2	----	24.2
SW. corner, 75 ft. N. of	B_{2g2}	16–33	.3	.8	.1	3.1	2.4	----	[2] 54.4	----	38.9
fence and 50 ft. W. of	C	33–48	.4	1.3	1.4	1.7	4.4	----	[2] 52.2	----	38.6
creek break.	C_g	48–60	.7	7.3	5.4	7.5	6.0	----	[2] 52.2	----	21.0
Sample No. 55-SD-6-14;											
Lab. No. F140-45.											
Lismore silty clay loam	A_{1p}	0–5	1.0	4.0	4.4	4.2	4.9	----	[2] 51.3	----	30.2
Location: Sec. 26, T. 109 N.,	A_{11}	5–16	1.7	5.1	3.9	3.9	2.9	----	[2] 50.6	----	31.9
R. 48 W.; 75 ft. E. and 55	B_2A_1	16–20	3.0	4.6	5.0	3.9	5.8	----	[2] 45.6	----	32.1
ft. N. of W. ¼ fence	B_2	20–25	3.6	1.1	7.4	7.7	5.3	----	[2] 43.6	----	31.4
corner.	B_{3ca}	25–34	4.6	5.5	9.3	8.7	6.3	----	[2] 38.1	----	27.5
Sample No. 55-SD-6-23;	C_{ca1}	34–46	7.9	5.1	5.1	6.2	5.1	----	[2] 42.0	----	28.6
Lab. No. F1498-1504.	C_{ca2}	46–60	7.4	6.3	5.5	5.1	4.2	----	[2] 43.4	----	28.1
Maddock sandy loam	A_{1p}	0–8	1.5	34.1	24.2	13.5	3.1	2.3	6.8	4.3	10.3
Location: Sec. 24, T. 111 N.,	B_2	8–21	2.8	32.5	25.1	9.1	12.1	6.4	4.2	1.9	5.9
R. 51 W.; 0.2 mi. N. and	C_1	21–48	5.3	28.8	37.5	13.5	2.3	7.6	.9	1.4	2.7
120 ft. E. of SE. corner.	C_{ca}	48–60	.9	14.9	28.3	25.0	7.6	5.7	2.8	9.7	5.1
Sample No. 55-SD-6-2;											
Lab. No. 2503-06.											
Oak Lake silt loam	A_{1p}	0–7	1.7	4.5	6.3	6.3	1.2	----	[2] 56.9	----	23.1
Location: Sec. 9, T. 112 N.,	A_1B_{2ca}	7–11	2.8	6.5	8.2	8.0	5.2	----	[2] 46.7	----	22.6
R. 47 W.; 0.3 mi. S. of	$B_{2ca}C_{ca}$	11–20	4.4	8.1	6.9	8.8	5.9	----	[2] 41.9	----	24.0
NE. corner.	$C_{ca}B_{2ca}$	20–25	7.0	6.3	8.8	6.7	5.5	----	[2] 35.0	----	30.7
Sample No. 55-SD-6-10;	C_{ca}	25–40	5.2	6.5	11.2	3.6	3.5	----	[2] 35.2	----	34.6
Lab. No. 2623-28.	C	40–60	6.4	8.8	11.6	10.1	8.2	----	[2] 29.5	----	25.5
Oldham silty clay loam	A_{10}	0–9	.3	.5	1.7	2.0	3.1	----	[2] 60.6	----	31.8
Location: Sec. 17, T. 110 N.,	A_{11}	9–14	.3	1.1	1.2	1.8	2.9	----	[2] 59.5	----	33.2
R. 51 W.; 100 ft. N. and	B_{2gca}	14–38	.4	2.0	1.5	2.0	5.3	----	[2] 52.5	----	36.4
110 ft. W. of S. ¼corner.	C_{gca}	38–60	.9	1.9	2.7	4.6	10.1	----	[2] 46.4	----	33.5
Sample No. 55-SD-6-16;											
Lab. No. F151-4.											

data for important soils—Continued

Textural class	Chemical analysis: Cation exchange capacity	Exchangeable cations (milliequivalents per 100 grams): Ca	Mg	Na	K	H	Electrical conductivity (Ec x 10³)	PH: Saturated paste	PH: 1:10	CaCo3 equivalent	Organic matter	Nitrogen
										Percent	Percent	Percent
Sandy loam	15.26	7.82	3.10	.73	.60	--------	1.40	6.5	6.7	.54	2.40	.1440
Sandy loam	9.71	5.61	2.56	1.10	.10	--------	.90	6.0	6.7	.48	1.02	.0853
Loamy sand	6.79	3.12	2.41	.33	.16	--------	.35	6.5	6.7	.35	.42	.0377
Sandy loam	11.33	6.83	2.95	.83	.20	--------	.30	6.4	6.5	.82	.41	.0366
Loam	20.27	13.09	5.55	.74	.18	--------	.55	6.5	6.6	1.11	.68	.0303
Silty loam	29.56	18.62	9.24	.37	.67	--------	.80	7.5	7.4	.83	5.68	.2589
Silty clay loam	27.00	15.24	9.65	.76	.66	--------	.80	6.8	6.9	.81	3.72	.1799
Silty clay loam	25.68	--------	--------	.74	.65	--------	1.10	7.0	7.0	2.14	1.84	.1352
Silty clay loam	23.69	12.44	9.95	.73	.66	--------	.80	6.9	7.0	1.72	1.19	.0919
Loam	14.48	(3)	(3)	.78	.60	--------	.65	8.0	8.2	21.85	.22	.0481
Clay loam	16.40	(3)	(3)	.76	.65	--------	.60	8.3	8.5	24.14	.12	.0441
Silt loam	27.92	13.32	7.61	.54	1.26	--------	.80	6.0	7.3	1.28	5.66	.2604
Silt loam	28.03	13.91	9.30	.48	.51	--------	.50	6.2	7.3	1.42	3.58	.1779
Silt loam	26.73	13.84	9.86	.36	.89	--------	.57	6.4	6.9	1.46	2.12	.1206
Silt loam	23.48	(3)	(3)	.69	.96	--------	.65	7.1	7.3	2.58	1.25	.0791
Loam	15.58	(3)	(3)	.77	.89	--------	.55	7.7	8.2	24.07	.35	.0386
Clay loam	14.32	(3)	(3)	1.38	.13	--------	.50	7.8	8.1	26.80	.23	.0302
Silty clay loam	41.79	(3)	(3)	.16	1.14	--------	1.1	7.6	7.8	10.56	20.47	.5755
Silt loam	43.82	(3)	(3)	.76	.52	--------	3.1	7.7	7.8	11.66	16.66	.5223
Silt loam	40.90	(3)	(3)	.12	.46	--------	3.7	7.6	7.6	10.07	11.10	.3502
Silty clay loam	39.74	(3)	(3)	.67	.45	--------	2.5	7.6	7.9	22.17	9.95	.3322
Silty clay loam	30.23	(3)	(3)	.39	.62	--------	1.3	7.5	8.1	15.29	3.18	.1546
Silt loam	23.71	17.03	5.85	.30	.53	--------	.9	7.5	7.5	4.05	.58	.0498
Silty clay loam	36.37	21.71	10.22	.35	.42	3.67	.71	6.0	6.9	--------	--------	.3348
Silty clay loam	34.40	20.68	10.71	.19	.41	2.41	.47	6.3	6.9	--------	--------	.2304
Clay loam	33.32	21.87	10.69	.31	.45	--------	.38	7.4	7.5	--------	--------	.1300
Clay loam	32.48	21.37	10.41	.30	.40	--------	.43	7.7	8.2	--------	--------	.0786
Clay loam	18.34	(3)	(3)	.15	.41	--------	.45	7.8	8.7	--------	--------	.0663
Clay loam	15.42	(3)	(3)	.12	.36	--------	.47	7.8	8.9	--------	--------	.0515
Clay loam	14.61	(3)	(3)	.24	.37	--------	.48	7.8	8.9	--------	--------	.0348
Sandy loam	11.66	7.84	2.70	.28	.12	--------	.30	7.0	7.0	.76	2.20	.1017
Loamy sand	9.34	4.86	2.49	.73	.63	--------	.20	6.7	7.4	.54	.86	.0570
Sand	5.02	2.74	1.56	.54	.63	--------	.15	7.0	7.4	.52	.11	.0424
Loamy sand	6.80	(3)	(3)	.54	.69	--------	.30	7.5	7.9	8.59	.12	.0284
Silt loam	32.57	20.45	10.14	.06	.15	--------	.75	7.1	7.4	9.45	5.12	.2464
Loam	28.67	(3)	(3)	.34	.11	--------	.60	7.6	8.1	6.80	3.60	.1571
Loam	27.11	(3)	(3)	.39	.12	--------	.55	7.6	8.4	10.56	3.06	.1433
Clay loam	21.33	(3)	(3)	.35	.12	--------	.45	7.6	8.7	22.03	1.20	.0389
Clay loam	19.47	(3)	(3)	.34	.13	--------	.40	7.8	8.9	27.40	1.11	.0231
Loam	15.01	(3)	(3)	.32	.12	--------	.50	7.6	8.9	23.04	.88	.0113
Silty clay loam	47.55	(3)	(3)	1.04	.61	--------	3.28	7.5	7.7	8.88	11.45	.3623
Silty clay loam	43.95	(3)	(3)	.68	.53	--------	2.02	7.5	7.8	6.87	9.34	.2470
Silty clay loam	35.67	(3)	(3)	.49	.51	--------	1.42	7.5	8.0	13.96	5.18	.1009
Clay loam	28.88	(3)	(3)	.29	.68	--------	.97	7.4	7.9	7.10	1.59	.0702

TABLE 5.—*Mechanical and chemical analytical*

Soil, location, sample and laboratory numbers	Horizon	Depth	Mechanical analysis								
			Particle size distribution in millimeters								
			Very coarse sand (2–1)	Coarse sand (1–0.5)	Medium sand (0.5–0.25)	Fine sand (0.25–0.10)	Very fine sand (0.10–0.05)	Coarse silt (0.05–0.02)	Medium silt (0.02–0.005)	Fine silt (0.005–0.002)	Clay <0.002
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Poinsett silt loam	A_{1p}	0– 6	.4	1.2	2.9	5.8	10.3	--------	[2] 58.6	--------	20.8
Location: Sec. 31, T. 112 N.,	B_1	6– 9	1.0	1.6	4.8	5.3	14.4	--------	[2] 50.0	--------	22.9
R. 52 W.; 0.2 mi. N. of	B_2	9–26	.3	.4	2.4	11.3	15.6	--------	[2] 45.3	--------	24.7
E. ¼corner.	C_{ca}	26–42	.5	.4	.5	4.5	27.8	--------	[2] 39.7	--------	26.6
Sample No. 55–SD–6–6;	C_1	42–48	1.1	.2	1.0	4.5	26.8	--------	[2] 40.2	--------	26.2
Lab. No. 2513–19.	C_2	48–52	.4	.6	10.3	25.8	22.1	--------	[2] 21.8	--------	19.0
	C_3	52–60	.1	.3	2.4	12.4	28.6	--------	[2] 38.7	--------	17.5
Renshaw sandy loam	A_{1p}	0– 4	11.8	27.0	13.1	6.0	3.3	--------	[2] 24.5	--------	14.4
Location: Sec. 12, T. 109 N.,	B_1	4– 9	9.6	25.7	14.3	6.5	3.5	--------	[2] 24.3	--------	16.2
R. 50 W.; 50 ft. S. and 50	B_2	9–15	10.5	29.8	21.6	9.3	3.7	--------	[2] 13.1	--------	12.0
ft. E. of N. ¼corner.	D_{ca}	15–22	14.1	30.9	27.7	10.8	2.8	--------	[2] 7.0	--------	6.7
Sample No. 55–SD–6–30;	D	22+	21.3	32.3	23.9	10.4	1.7	--------	[2] 6.5	--------	3.9
Lab. No. 1541–45.											
Sinai silty clay [4]	A_p	0– 6	.3	.5	.5	1.3	3.0	--------	[2] 53.0	--------	41.4
Location: Sec. 18, T. 109 N.,	B_{21}	6–12	.2	.1	.2	.5	2.5	--------	[2] 50.1	--------	46.4
R. 52 W.; 0.3 mi. E., 300	B_{22}	12–19	--------	.1	.1	.5	3.1	--------	[2] 52.2	--------	44.0
ft. N. of SW. corner.	B_{3ca}	19–26	--------	.1	.2	.6	2.6	--------	[2] 56.5	--------	40.0
Sample No. S–54–SD–6–1	C_{ca}	26–35	.1	--------	.1	.5	2.1	--------	[2] 52.4	--------	44.8
(1-7) and 55-SD-6-19; *Lab.*	C_1	35–50	.1	.2	.2	.6	4.1	--------	[2] 53.7	--------	41.1
No. 2255-2261, (Mandan).	C_2	50–60	.1	.3	.3	4.0	9.6	--------	[2] 46.7	--------	39.0
Solomon clay	A_0–A_1	0– 1	--------	--------	--------	--------	--------	--------	40.0	--------	42.9
Location: Sec. 29, T. 110 N.,	A_1	1– 7	4.1	2.3	2.6	2.4	2.3	--------	[2] 37.7	--------	48.8
R. 50 W.; SE. corner.	B_{2g1}	7–14	1.4	2.8	3.0	2.3	3.0	--------	[2] 38.4	--------	49.3
Sample No. 55–SD–6–7;	B_{2g2}	14–22	2.7	4.6	2.5	2.8	3.4	--------	[2] 35.3	--------	48.4
Lab. No. 2604–10.	C_{gca1}	22–36	3.6	6.5	5.8	2.7	1.4	--------	[2] 34.7	--------	45.4
	C_{gca2}	36–43	8.3	9.6	8.6	6.8	4.8	--------	[2] 37.8	--------	24.8
	C_{gca2}–D_g	43–60+	17.9	19.6	15.2	8.9	11.4	--------	[2] 13.5	--------	13.5
Vienna loam (Iowan till)	A_{1p}	0– 8	2.0	11.6	10.2	8.9	10.3	--------	[2] 34.4	--------	22.7
Location: Sec. 25, T. 112 N.,	B_{21}	8–13	2.1	15.0	8.7	7.7	7.4	--------	[2] 37.9	--------	21.2
R. 49 W.; 145 ft. N. and	B_{22}	13–18	3.8	8.0	12.0	12.0	7.1	--------	[2] 32.3	--------	24.8
60 ft. W. of center of	C_{ca}	18–40	3.2	7.2	11.8	7.3	8.9	--------	[2] 33.3	--------	28.3
section.	C	40–60	3.1	7.2	11.9	9.8	7.9	--------	[2] 33.8	--------	26.3
Sample No. 55–SD–6–18;											
Lab. No. F161–65.											
Vienna loam (Tazewell till)	A_{1p}	0– 6	3.6	9.6	11.4	5.6	6.5	--------	[2] 38.8	--------	24.5
Location: Sec. 25, T. 112 N.,	AB	6–11	--------	--------	[1] 30.6	--------	--------	--------	[2] 41.7	--------	27.7
R. 49 W.; 0.15 mi. N. of	B_2	11–20	4.0	6.5	10.7	8.3	2.2	--------	[2] 38.2	--------	30.1
E. ¼ corner.	B_{3ca}	20–28	6.0	9.9	13.2	8.5	5.1	--------	[2] 34.1	--------	23.2
Sample No. 55–SD–6–9;	C_{ca}	28–46	5.9	11.9	18.2	4.4	4.1	--------	[2] 36.4	--------	19.1
Lab. No. 2617–22.	C	46–60	8.2	8.4	10.4	9.2	5.8	--------	[2] 36.3	--------	21.7

[1] Total sand (2–0.5 mm.).
[2] Total silt (0.05–0.002 mm.).

data for important soils—Continued

Textural class	Chemical analysis											
	Cation exchange capacity	Exchangeable cations (milliequivalents per 100 grams)					Electrical conductivity ($Ec \times 10^3$)	PH		CaCo3 equivalent	Organic matter	Nitrogen
		Ca	Mg	Na	K	H		Saturated paste	1:10	*Percent*	*Percent*	*Percent*
Silt loam	31.11	20.61	7.16	.54	.89		.70	7.2	7.6	1.88	5.37	.2509
Loam	26.70	17.27	7.85	1.15	.13		.40	7.4	7.5	1.59	3.01	.1580
Loam	23.23	14.45	8.80	1.12	.11		.55	7.5	7.6	1.72	1.66	.1519
Loam	18.64	(3)	(3)	1.38	.13		.45	7.7	8.3	21.77	.60	.1324
Loam	18.45	(3)	(3)	1.07	.26		.50	7.9	8.4	20.00	.76	.1087
Sandy loam	14.90	(3)	(3)	1.51	.32		.60	7.9	8.4	13.94	.23	.0707
Loam	17.59	(3)	(3)	1.85	.33		.60	7.8	8.5	14.91	.26	.0335
Sandy loam	31.39	23.76	7.20	.14	.29		.80	7.6	8.0			.2937
Sandy loam	28.65	21.20	7.08	.13	.24		.70	7.8	8.2			.2352
Sandy loam	18.64	13.78	4.60	.09	.17		.60	7.9	8.2			.1368
Gravel	5.77	(3)	(3)	.08	.09		.50	8.0	8.9			.0993
Gravel	3.74	(3)	(3)	.04	.09		.50	8.0	9.0			.0264
Silty clay	34.6	22.4	8.0	.1	2.7		.7	6.1	6.9		[5] 3.39	.304
Silty clay	32.5	21.6	10.1	.2	1.0		.8	6.4	7.2		[5] 1.57	.154
Silty clay	31.4	21.6	11.3	.1	.6		.7	7.0	7.9		[5] 1.07	.108
Silty clay; silty clay loam.	25.0	(3)	(3)	.1	.4		.7	7.7	8.9	.18	[5] .66	.068
Silty clay	25.4	(3)	(3)	.3	.4		.6	7.8	9.1	.20	[5] .45	
Silty clay	24.0	(3)	(3)	.5	.3		.6	7.9	9.1	.18	[5] .34	
Silty clay loam	22.8	(3)	(3)	.7	.4		.7	7.9	9.1	.17	[5] .25	
Clay	56.25	(3)	(3)									.9422
Clay	49.72	(3)	(3)	.87	.63		1.95	7.9	8.0	18.98	7.48	.4905
Clay	40.59	(3)	(3)	.33	.62		1.10	7.9	8.0	22.92	6.80	.3341
Clay	31.40	(3)	(3)	.46	.60		.85	7.9	8.2	24.05	3.13	.1565
Clay	26.50	(3)	(3)	.13	.25		.70	7.9	8.1	24.21	2.00	.0905
Loam	17.71	(3)	(3)	.59	.60		.80	8.0	8.1	12.31	.65	.0232
Sandy loam	8.61	(3)	(3)	.53	.61		.75	7.9	8.1	16.52	.33	.0072
Loam	29.47	18.10	8.85	.13	.31	2.08	.74	6.3	6.7		7.22	.2259
Loam	27.01	18.24	7.82	.11	.35	.49	.59	7.0	6.9			.1309
Loam	29.26	20.02	8.78	.11	.35		.61	7.7	7.7	3.14		.0766
Clay loam	15.62			.17	.26		.71	7.8	8.2	18.95		.0141
Loam		(3)	(3)	.35	.29		.68	8.0	8.7	16.80		.0069
Loam	24.23	Calc.	Calc.	.61	.61		1.0	7.7	7.7	2.42	3.77	.2425
Clay loam	24.08	16.38	7.37	.82	.61		.70	7.4	7.4	1.86	2.80	.1776
Clay loam	21.71			.68	.61		.70	7.0	7.1	1.86	1.07	.1064
Loam	16.31	(3)	(3)	.48	.14		.6	7.7		26.16	.59	.0636
Loam	12.93	(3)	(3)	.32	.12		.6	7.9		24.48	.08	.0224
Loam	15.26	(3)	(3)	.36	.12		.55	8.0		25.49	.18	.0163

[3] Calcareous; cations not determined.
[4] Analysis by Soil Conservation Laboratory, Mandan, N. Dak.
[5] Organic carbon.

through moisture-conserving practices is much greater than indicated by the relatively small quantities of water than can be stored. One inch of conserved water accounts for about 5 to 6 bushels of oats per acre, if the annual precipitation is enough to meet minimum requirements or to prevent crop failure.

Moisture-conserving crops like corn or sorghum leave a reserve of moisture in the soil for crops that follow. Terracing and contour stripcropping reduce runoff and conserve water. The moisture wasted by weeds is a serious loss in Brookings County. For each pound of dry matter produced, lambsquarter uses about 801 pounds of water, and cocklebur, about 432 pounds. A relatively light growth of 500 pounds of lambsquarter or sunflower plants per acre uses enough moisture to produce 7 to 8 bushels of corn per acre. If each acre in Brookings County produced 1,000 pounds of weeds, more water would be lost each year by transpiration through the weeds than the total amount of water in Lake Poinsett (figured at an average depth of 10 feet).

One of the most effective but least expensive methods of controlling weeds is to plant only clean seed. If weeds become established, cultural or chemical methods of eradication must be used. Cultural methods include the use of good rotations and competing crops. In a crop rotation such as corn-oats-alfalfa, several opportunities occur to cut weeds close to the ground before the seeds mature. Cutting will eliminate most annual weeds, but wild oats may survive. A successful method currently used for controlling wild oats is to delay seeding and to cultivate lightly in the fall and in the spring before seeding.

Noxious weeds that have spreading or creeping roots are difficult to control by tillage. Cultural methods for control of these weeds include the use of competitive crops, intertilled crops, or intensive cultivation. Competitive crops are alfalfa, sweetclover, winter rye, close-drilled sorghum, and sudangrass. Additional information on weed control can be obtained from the county agent or from South Dakota State College.

Control of wind erosion

Practices for control of wind erosion are (1) reducing wind velocity, (2) trapping the moving soil, (3) using vegetative cover, and (4) maintaining a stable granular structure.

Wind velocity can be reduced by planting shelterbelts, but the trees take several years to grow high enough to be effective. The area affected by the shelterbelt is about five times the height of the trees on the windward side and 20 to 30 times the height on the leeward side.

Moving soil particles are trapped by planting strips of grasses or legumes that alternate with strips of corn or wheat. Deep listing also traps moving soil particles. If the listing is done in time, the furrows may effectively control weeds. Any implement that leaves the soil rough or cloddy or in rough ridges can be used in an emergency for wind-erosion control.

Use of a vegetative cover is one of the most important ways to reduce wind erosion. For maximum soil protection, crop residues should be left on the surface whenever possible rather than plowed under. A small-grain stubble, together with the straw from the combine, greatly reduces the velocity of the wind at ground level and decreases erosion.

Regular additions of organic matter to the soil aid in erosion control by increasing the size and stability of the soil aggregates.

Control of water erosion

On long slopes water erosion may be controlled by terraces, contour cultivation, contour stripcropping, and the seeding of waterways.

Short slopes are not well suited to contour farming, but erosion may be controlled on them by keeping the soil in grasses and legumes most of the time. These plants provide a protective cover and add organic matter. The organic matter improves the soil structure. As a result, water infiltrates the soil more rapidly and runoff and soil loss are reduced. Soils high in organic matter are also high in aggregates that resist breakdown and movement by rapidly moving water.

Soil Management Groups and Subgroups

The soils of Brookings County have been divided into 8 broad management groups, generally on the basis of physiography, drainage, and texture. These groups have been subdivided into 27 subgroups, each of which contains soils that have similar management problems and productivity (See table 6).

Management group 1

This group consists of nearly level, moderately well drained, loamy soils. It is subdivided into subgroups 1A and 1B.

SUBGROUP 1A.—MODERATELY WELL DRAINED LOAMY SOILS OF UPLAND FLATS AND BROAD RIDGETOPS

Brookings silty clay loam, nearly level.
Lismore silty clay loam, nearly level.
Oak Lake silt loam, nearly level.
Waubay silty clay loam, nearly level.

Management problems.—Management that includes the use of legumes and fertilizers is needed to maintain organic matter, nitrogen, and phosphorus.

Crop suitability.—The soils in this subgroup are among the best soils in the county for general crops.

SUBGROUP 1B.—MODERATELY WELL DRAINED LOAMY SOILS OF UPLAND DRAINAGEWAYS AND FOOT SLOPES

Brookings silty clay loam, drainageways.
Lismore silty clay loam, drainageways.
Oak Lake silty clay loam, drainageways.
Waubay silty clay loam, drainageways.

Management problems.—Management that includes the use of legumes and fertilizers is needed to main-

tain organic matter, nitrogen, and phosphorus. Delayed planting may be a problem in wet years.

Crop suitability.—The soils in this subgroup are among the best soils in the county for general crops.

Management group 2

This group consists of nearly level, gently sloping or gently undulating, well-drained, loamy soils of the uplands. It is subdivided into subgroups 2A, 2B, 2C, and 2D.

SUBGROUP 2A.—NEARLY LEVEL, WELL-DRAINED LOAMY SOILS, USUALLY ON BROAD RIDGETOPS

Flandreau loam, deep, nearly level.
Flandreau silt loam, deep, nearly level.
Flandreau loam, deep over till, nearly level.
Flandreau silt loam, nearly level.
Kranzburg loam, nearly level.
Kranzburg silt loam, nearly level.
Moody silt loam, nearly level.
Poinsett silt loam, nearly level.
Vienna loam, nearly level.

Management problems.—Management that includes the use of legumes and fertilizers is required to maintain organic matter, nitrogen, and phosphorus.

Crop suitability.—The soils in this subgroup are among the best soils in the county for general crops.

SUBGROUP 2B.—WELL-DRAINED LOAMY SOILS HAVING GENTLE SLOPES

Flandreau silt loam, gently sloping.
Flandreau loam, deep, gently undulating.
Flandreau loam, deep over till, gently sloping.
Kranzburg loam, gently sloping.
Kranzburg silt loam, gently sloping.
Moody silt loam, gently sloping.
Vienna loam, gently sloping.

Management problems.—Management that includes the use of legumes and fertilizer is required to maintain organic matter, nitrogen, and phosphorus. The slight water-erosion hazard on these soils may be offset by contour farming.

Crop suitability.—All crops generally grown in the county are suited to the soils of this subgroup.

SUBGROUP 2C.—WELL-DRAINED LOAMY SOILS OF GENTLY UNDULATING AREAS

Ahnberg-Poinsett complex, gently undulating.
Poinsett silt loam, gently undulating.
Singsaas loam, gently undulating.

Management problems.—Management that includes the use of legumes and fertilizer is required to maintain organic matter, nitrogen, and phosphorus. These soils have a slight water-erosion hazard. In areas having more regular slopes this problem may be met by contour farming.

Crop suitability.—All crops generally grown in the county are suited to the soils of this subgroup.

SUBGROUP 2D.—WELL-DRAINED SILTY CLAY LOAMS OF NEARLY LEVEL TO GENTLY SLOPING TABLELANDS

Sinai silty clay loam, nearly level.
Sinai silty clay loam, gently sloping.

Management problems.—Management that includes the use of legumes and fertilizer is needed to maintain organic matter, nitrogen, and phosphorus. The fairly fine texture of these soils may cause them to become cloddy if they are worked when too wet. Tilth may be improved by the addition of organic matter.

Crop suitability.—All crops generally grown in the county are suited to the soils of this subgroup.

Management group 3

This group consists of undulating or sloping loamy upland soils. It is divided into subgroups 3A, 3B, and 3C.

SUBGROUP 3A.—SLOPING LOAMY SOILS

Flandreau loam, deep over till, sloping.
Kranzburg silt loam, sloping.
Vienna loam, sloping.

Management problems.—These soils have a moderate water-erosion hazard, which can be offset by contour farming. The problem of maintaining organic matter, nitrogen, and phosphorus can be met by management that includes the use of legumes and fertilizer.

Crop suitability.—All crops generally grown in the area are suited to the soils of this subgroup.

SUBGROUP 3B.—UNDULATING LOAMY SOILS

Ahnberg-Poinsett complex, undulating.
Poinsett silt loam, undulating.
Singsaas loam, undulating.

Management problems.—These soils have a moderate water-erosion hazard. In areas having more regular slopes this problem can be met by contour farming. The problem of maintaining organic matter, nitrogen, and phosphorus can be met by management that includes the use of legumes and fertilizer.

Crop suitability.—All crops generally grown in the area are suited to the soils of this subgroup. To control erosion it may be necessary to use more sod crops on these soils than on those of subgroup 3A.

SUBGROUP 3C.—WELL-DRAINED SILTY CLAY LOAM OF SLOPING TABLELANDS

Management problems.—Sinai silty clay loam, sloping, is the only soil in subgroup 3C. It has a moderate water-erosion hazard. Contour farming will eliminate this hazard on the more regular slopes. Because of fairly fine texture, this soil may become cloddy if worked when too wet. Tilth may be improved by the addition of organic matter. Nitrogen and phosphorus can be maintained by management that includes the use of legumes and fertilizer.

Crop suitability.—All crops generally grown in the area are suited to the soil of this subgroup. To control erosion, it may be necessary to use more sod crops on this soil than on those of subgroup 2D.

Management group 4

This group consists of rolling, thin, loamy soils. It is subdivided into subgroups 4A and 4B.

SUBGROUP 4A.—ROLLING, THIN, LOAMY SOILS

Management problems.—The only soil unit in this subgroup—Buse complexes, rolling—is on hilly terrain, where the amount and rate of runoff is high. If cultivated, this unit erodes severely; moreover, machinery is difficult to use on the steep slopes. Pastures in this complex require improvement and maintenance.

Crop suitability.—Pasture grasses and legumes are suitable. If cropped, the soils are better suited to small grains than to row crops.

SUBGROUP 4B.—ROLLING, THIN, STONY, LOAMY SOILS

Management problems.—The only unit in subgroup 4B is Buse stony complexes, rolling. Because of the thin profiles, hilly terrain, and stoniness, this complex is best suited to pasture. If cultivated, the soils erode severely; moreover, machinery is difficult to use on the steep slopes. Pastures on this complex require improvement and maintenance.

Crop suitability.—Pasture grasses and legumes are suited to this complex.

Management group 5

This group consists of complex soil areas. The soils occur together in patterns that are so intricate that the individual types and phases cannot be shown on a map of the scale used. The group is subdivided into subgroups 5A, 5B, 5C, and 5D. These subgroups differ from each other in their ratio of thick to thin soils and in their general relief.

SUBGROUP 5A.—SOILS IN LANDSCAPE COMPOSED OF SHALLOW KNOBS OR BREAKS (25 PERCENT) INTERSPERSED WITH DEEPER SOILS (75 PERCENT)

Poinsett-Buse-Pierce soils, gently undulating.
Singsaas-Buse loams, gently undulating.
Vienna-Buse loams, gently undulating.

Management problems.—Maintaining organic matter, nitrogen, and phosphorus is a problem for all of these soils, especially the thin soils on the knobs and breaks. This problem can be met by management that includes the use of legumes and fertilizer.

Crop suitability.—All crops generally grown in the area are suited to the soils of this subgroup. Yields are smaller on the thin soils. More sod crops should be grown on the thin soils than on the thick ones.

SUBGROUP 5B.—SOILS IN LANDSCAPE OF SHALLOW KNOBS OR BREAKS (30 TO 35 PERCENT) INTERSPERSED WITH DEEPER SOILS (65 TO 70 PERCENT)

Buse complexes, undulating.
Buse stony complexes, undulating.
Poinsett-Buse-Pierce soils, undulating.
Singsaas-Buse loams, undulating.
Singsaas-Buse-Pierce loams, undulating.
Vienna-Buse loams, undulating.
Vienna-Buse-Pierce loams, undulating.

Management problems.—Management that includes the use of legumes and fertilizer is required to maintain organic matter, nitrogen, and phosphorus. Control of water erosion is needed on these soils. Because the landscape is irregular, contour farming may be difficult, and erosion may have to be controlled by the use of more sod crops.

Crop suitability.—Small grains are better suited than row crops to the shallow soils of these complexes.

SUBGROUP 5C.—SOILS IN LANDSCAPE OF SHALLOW KNOBS OR BREAKS (50 TO 60 PERCENT) INTERSPERSED WITH DEEPER SOILS (40 TO 50 PERCENT)

Poinsett-Buse-Pierce soils, rolling.
Singsaas-Buse-Pierce loams, rolling.
Vienna-Buse-Pierce loams, rolling.
Vienna-Buse loams, steep.

Management problems.—A major problem is the control of water erosion. Because the landscape is irregular, contour farming is difficult, and erosion may have to be controlled by the use of sod crops. Moreover, the rolling terrain makes use of machinery difficult. The thin soils generally give low yields and especially need organic matter, nitrogen, and phosphorus.

Crop suitability.—Pasture grasses and legumes are suited to the soils of this subgroup. If these soils are cropped, small grains will be better suited than row crops.

SUBGROUP 5D.—SOILS IN LANDSCAPE OF SHALLOW KNOBS OR BREAKS (ABOUT 75 PERCENT) AND DEEPER SOILS (25 PERCENT) THAT GENERALLY OCCUR IN SHORT NARROW SWALES

Buse complexes, hilly.
Pierce complexes, hilly.

Management problems.—Because this group of soils is used for pasture, its management problems are those of improving and maintaining pasture.

Crop suitability.—Pasture grasses and legumes are suited to the soils of this subgroup.

Management group 6

This group consists of soils with gravel substrata. These soils normally occur on nearly level terraces; all are underlain by gravel. The five soils of this group are divided into subgroups on the basis of depth to gravel.

SUBGROUP 6A.—WELL-DRAINED LOAMY SOILS, DEEP OVER GRAVEL

Estelline silt loam, nearly level.
Estelline silt loam, gently sloping.
Fordville loam, deep, nearly level.

Management problems.—The problem of maintaining organic matter, nitrogen, and phosphorus can be met by management that includes the use of legumes and fertilizer. These soils may be slightly droughty during periods of low rainfall.

Crop suitability.—The soils in this subgroup are among the best for the crops generally grown in the county.

SUBGROUP 6B.—MODERATELY WELL DRAINED LOAMY SOIL THAT IS DEEP OVER GRAVEL AND OCCURS IN DRAINAGEWAYS

Management problems.—Athelwold silty clay loam, nearly level, is the only soil in subgroup 6B. The problem of maintaining organic matter, nitrogen, and phosphorus can be met by management that includes the use of legumes and fertilizers.

Crop suitability.—The soil in this subgroup is among the best for the crops generally grown in the county.

SUBGROUP 6C.—WELL-DRAINED LOAMY SOILS, MODERATELY SHALLOW OVER GRAVEL

Estelline silt loam, moderately shallow, nearly level.
Estelline silt loam, moderately shallow, gently sloping.
Fordville loam, nearly level.
Fordville loam, gently undulating.
Fordville loam, thick solum, nearly level.

Management problems.—Because the gravel substrata are fairly near the surface, moderated droughtiness is a problem for this group of soils. Such crops as small grains can be produced, because they grow during the wettest part of the year. The problem of maintaining organic matter, nitrogen, and phosphorus can be met by management that includes the use of legumes and fertilizer.

Crop suitability.—The soils of this subgroup are better suited to small grains than to corn.

SUBGROUP 6D.—WELL-DRAINED SOILS, SHALLOW OVER GRAVEL

Renshaw sandy loam, nearly level.
Renshaw sandy loam, gently sloping.

Management problems.—Because of the shallow depth to gravel, the main problem of management is severe droughtiness. The droughtiness may be partly offset by planting small grains or other crops that make most of their growth during the wettest part of the year. The problem of maintaing organic matter, nitrogen, and phosphorus can be met by management that includes the use of legumes and fertilizer.

Crop suitability.—Small grains are better suited than corn to the soils of this subgroup.

SUBGROUP 6E.—SOMEWHAT EXCESSIVELY DRAINED SOILS, VERY SHALLOW OVER GRAVEL

Sioux gravelly loam, gently undulating.
Terrace escarpments, sloping.

Management problems.—Because of the coarse substrata and generally sandy profiles, these thin soils have low fertility and are subject to severe droughtiness and high wind erosion. These problems can be met best by the use of permanent sod crops.

Crop suitability.—Pasture and hay crops are suited to units of this subgroup.

Management group 7

This group consists of sandy soils. It is subdivided into subgroups 7A, 7B, and 7C.

SUBGROUP 7A.—WELL-DRAINED SANDY LOAMS ON LOW TERRACES OR UPLANDS

Egeland sandy loam, nearly level.
Egeland sandy loam, gently undulating.
Fordville sandy loam, nearly level.
Fordville sandy loam, gently undulating.
Hecla loam, undulating.

Management problems.—The control of wind erosion and the maintenance of organic matter, nitrogen, and phosphorus are the main problems on these soils. In favorable weather, drifting can be prevented by wind stripcropping and stubble mulch tillage. If the weather is unfavorable and there is no cover, deep chiseling will help hold the soils. Fertility and organic matter can be maintained by management that includes the use of legumes and fertilizer.

Crop suitability.—Small grains and corn are suited to the soils of this subgroup.

SUBGROUP 7B.—EXCESSIVELY DRAINED LOAMY SANDS AND SANDS ON LOW TERRACES AND UPLANDS

Hecla sandy loam, nearly level.
Maddock sandy loam, nearly level.
Maddock sandy loam, undulating.

Management problems.—The control of wind erosion and the maintenance of organic matter, nitrogen, and phosphorus are the main problems on these soils. The soils are extremely susceptible to drifting. Because they are sandy, they do not clod well. Moreover, it is difficult to keep the surface rough enough to control drifting. Usually, these soils must be kept in perennial vegetation or protected by a growing crop or by crop residues throughout the year. If the soils have no vegetation, deep chiseling may help control soil drifting. Fertility and organic matter can be maintained by management that includes the use of legumes and fertilizer.

Crop suitability.—Small grains and corn are suited to the soils of this subgroup.

SUBGROUP 7C.—SANDY LOAM SOILS UNDERLAIN BY GLACIAL DRIFT AT DEPTHS RANGING FROM 20 TO 36 INCHES

Dickey sandy loam, gently undulating.
Dickey sandy loam, undulating.
Egeland sandy loam, deep over loamy drift, nearly level.
Egeland sandy loam, deep over loamy drift, gently undulating.
Vienna sandy loam, gently undulating.
Vienna sandy loam, undulating.

Management problems.—The main problems on these soils are the control of wind erosion and maintenance of organic matter, nitrogen, and phosphorus. To control erosion the soils should be protected by a growing crop or by crop residues. When the soils are bare, deep chiseling helps to control erosion. Organic matter and fertility can be maintained by a rotation that includes the use of legumes and fertilizer.

Crop suitability.—Small grains and corn are suited to the soils of this subgroup.

Management group 8

This group consists of poorly drained soils. It is subdivided into subgroups 8A, 8B, 8C, and 8D.

SUBGROUP 8A.—SOMEWHAT POORLY DRAINED SOILS, INTERMITTENTLY WET AND SHALLOW TO GRAVEL

Volga loam, somewhat poorly drained, nearly level.
Volga silty clay loam, somewhat poorly drained, nearly level.

Management problems.—During years when the weather is favorable for crop growth on well-drained upland soils, these soils are usually wet part of the time. When the weather is too dry for upland soils, it is favorable for the soils of this subgroup. The wetness of these soils may be overcome partly by growing crops that are planted late. The problem of maintaining organic matter, nitrogen, and phosphorus may be met by management that includes the use of legumes and fertilizer.

Crop suitability.—Because of spring wetness, crops with late planting dates are best suited to the soils of this subgroup. Areas of these soils that are narrow and cut by streams are best suited to pasture and hay crops.

SUBGROUP 8B.—SOMEWHAT POORLY DRAINED, INTERMITTENTLY WET SOILS

Hidewood silty clay loam, nearly level.
Lamoure silty clay loam, nearly level.
Leota silty clay loam, nearly level.
Oldham silty clay loam, nearly level.
Tetonka silty clay loam, nearly level.

Management problems.—During years when the weather is favorable for crops on well-drained upland soils, these soils are usually wet part of the time. Wetness may be overcome partly by growing crops that can be planted late. Organic matter, nitrogen, and phosphorus can be maintained by management that includes the use of legumes and fertilizer.

Crop suitability.—Because of spring wetness, crops with late planting dates are suited to the soils of this subgroup. Where the alluvial soils are cut by streams, they are best suited to hay and pasture.

SUBGROUP 8C.—POORLY DRAINED SOILS THAT ARE FREQUENTLY FLOODED OR HAVE A HIGH WATER TABLE

Solomon clay, nearly level.
Parnell silty clay loam, nearly level.
Volga silty clay loam, poorly drained, nearly level.

Management problems.—These soils are wet when the weather is favorable for crops in the uplands. During a sequence of dry years, the soils may be cultivated and produce good yields. Reed canarygrass will produce pasture or hay on these soils when they are too wet to cultivate.

Crop suitability.—During wet years reed canarygrass is suited to the soils of this subgroup. During a series of dry years, these soils may be planted to crops generally grown in the county.

SUBGROUP 8D.—VERY POORLY DRAINED MARSHY AREAS

Marsh.
Rauville silty clay loam, nearly level.

Management problems.—These units are generally too wet to be used for agriculture. Artificial drainage may improve them but will not insure regular cropping. Costs of drainage should be carefully balanced against anticipated return. Unimproved areas of these soils are excellent wildlife habitats, because food, cover, and water are plentiful.

Crop suitability.—Reed canarygrass may be grown for hay or pasture. If drained, these soils may produce good yields of the crops generally grown in the county.

Productivity of Brookings County Soils

Estimated yields for corn, oats, barley, flax, and spring wheat are given in table 6. In this table most of the soils of Brookings County are placed in their management groups and subgroups, and estimated yields are given for five different systems of management and three different growing conditions.

The crop yields listed for the different management systems are an indication of the productivity of the different soils. Soils vary in many ways, even on the same farm. Crop yields are affected by the sandiness, thickness, and permeability of the soil profiles, by physiography, and by other characteristics. Productivity is also influenced by management practices, such as use of fertilizer and rotation of crops.

To make wise decisions in organizing and managing his farm, a farmer needs to know the probable crop yields of his soils under different systems of management. Farmers who have worked the same farm for many years know how the soils respond to the different systems of management used. There are some systems, however, that they probably have not tried. Many have just begun to farm or have moved to farms that have soils they are not familiar with. To decide what crops to grow and how to manage the soils, farmers must estimate the yields they can expect from various systems of management. To assist these farmers, estimates of average acre yields of five important crops are given in table 6.

Several important limitations should be kept in mind when using this table. First, the yield figures are predictions rather than proven facts, but they are considered reliable enough to be valuable. Second, the predictions are for average yields that might be expected over a period of many years. Third, there is some variation in yields between areas of the same soil. Fourth, past management of a soil will affect its immediate response to new management practices. Fifth, the development of new crop varieties and new farming methods may affect future yields.

Growing conditions influencing yield predictions

Three growing conditions—unfavorable, favorable, and very favorable—were arbitrarily selected to show the influence of climate, soil management, and soil types on crop yields. The growing conditions in any one year may not fall precisely in any one of the three categories but may be between two of them. In border years the crop yields will be affected accordingly.

Unfavorable growing conditions have serious limitations of rainfall, adverse temperatures, or other fac-

TABLE 6.—*Estimated average yields of important crops in bushels per acre under five systems of soil ... three growing conditions for soils of management subgroups*

[The systems of management are as follows:

A—Corn–small grain rotation; no fertilizer.

B—Corn–small grain rotation; 30 to 40 pounds of available nitrogen and 20 to 30 pounds of available phosphate (P_2O_5) per acre appli... small grain.

C—Small grain (plus sweetclover catch crop)–corn rotation; 20 to 30 pounds of available nitrogen and 20 to 30 pounds of available ... spring to small grain and clover; sweetclover plowed under in spring when 8 to 10 inches high.

D—Small grain plus either sweetclover or red clover–clover for hay or seed followed by corn; 40 to 60 pounds of available phosphate pe... year the legume is planted or the following spring.

E—Small grain seeded to alfalfa, alfalfa 2 to 4 years–corn–small grain–corn; 60 to 80 pounds of available phosphate per acre applied ... the following fall or early the following spring. Alfalfa plowed under in fall shortly after second hay crop is removed.

[See text for definition of unfavorable, favorable, and very favorable growing conditions]

MANAGEMENT GROUP 1—NEARLY LEVEL MODERATELY WELL DRAINED LOAMY SOILS

Subgroup and soils	System of management	Unfavorable growing conditions					Favorable growing conditions					Very f...
		Corn	Oats	Barley	Flax	Spring wheat	Corn	Oats	Barley	Flax	Spring wheat	Corn
Subgroup 1A:												
Brookings silty clay loam, nearly level	A	29–31	33–35	22–24	8–9	13–14	44–46	51–53	34–36	12–13	20–21	54–56
Lismore silty clay loam, nearly level	B	34–36	37–39	26–28	9–10	15–16	52–54	67–69	47–49	15–16	27–28	64–66
Oak Lake silt loam, nearly level	C	31–33	36–38	25–27	9–10	15–16	50–52	64–66	44–46	14–15	26–27	62–64
Waubay silty clay loam, nearly level	D	30–32	38–40	27–29	10–11	16–17	54–56	66–68	46–48	17–18	30–31	69–71
	E	31–33	39–41	28–30	10–11	16–17	56–58	69–71	49–51	18–19	32–33	73–75
Subgroup 1B:[1]												
Brookings silty clay loam, drainageways	A	28–31	32–35	21–23	8–9	13–14	43–46	49–52	33–35	12–13	20–21	53–56
Lismore silty clay loam, drainageways	B	33–36	36–39	25–27	9–10	15–16	51–54	65–68	46–48	15–16	27–28	63–66
Oak Lake silty clay loam, drainageways	C	30–33	35–38	24–26	9–10	15–16	49–52	62–65	43–45	14–15	26–27	61–64
Waubay silty clay loam, drainageways	D	29–32	37–40	26–28	10–11	16–17	53–56	64–67	45–47	17–18	30–31	68–71
	E	30–33	38–41	27–29	10–11	16–17	55–58	67–70	48–50	18–19	32–33	72–75

MANAGEMENT GROUP 2—NEARLY LEVEL, GENTLY SLOPING OR GENTLY UNDULATING, WELL-DRAINED UPLAND LOAM...

Subgroup and soils	System of management	Corn	Oats	Barley	Flax	Spring wheat	Corn	Oats	Barley	Flax	Spring wheat	Corn
Subgroup 2A:												
Flandreau loam, deep, nearly level												
Flandreau silt loam, deep, nearly level												
Flandreau loam, deep over till, nearly level	A	24–27	28–31	19–21	7–8	11–12	35–38	40–43	27–29	10–11	16–17	46–49
Flandreau silt loam, nearly level	B	27–30	32–35	23–25	8–9	13–14	43–46	56–59	40–42	13–14	23–24	56–59
Kranzburg loam, nearly level	C	25–28	30–33	21–23	8–9	13–14	40–43	53–56	37–39	12–13	22–23	54–57
Kranzburg silt loam, nearly level	D	21–24	32–35	23–25	9–10	14–15	44–47	54–57	38–40	15–16	26–27	60–63
Moody silt loam, nearly level	E	25–28	34–37	25–27	9–10	14–15	47–50	58–61	42–44	16–17	28–29	63–66
Poinsett silt loam, nearly level												
Vienna loam, nearly level												
Subgroup 2B:												
Flandreau silt loam, gently sloping												
Flandreau loam, deep, gently undulating	A	22–25	25–28	17–19	6–7	10–11	33–36	38–41	25–27	8–10	15–16	44–47
Flandreau loam, deep over till, gently sloping.	B	25–28	29–32	21–23	7–8	12–13	41–44	54–57	38–40	11–13	22–23	54–57
	C	23–26	27–30	19–21	7–8	12–13	38–41	51–54	35–37	10–12	21–22	52–55
Kranzburg loam, gently sloping	D	19–22	29–32	21–23	8–9	13–14	42–45	52–55	36–38	13–15	25–26	58–61
Kranzburg silt loam, gently sloping	E	23–26	31–34	23–25	8–9	13–14	45–48	56–59	40–42	14–16	27–28	61–64
Moody silt loam, gently sloping												
Vienna loam, gently sloping												

TABLE 6.— *Yields of crops in bushels per acre—Brookings County, S.D.—Continued*

Subgroup and soils	System of management	Unfavorable growing conditions					Favorable growing conditions					Very fa
		Corn	Oats	Barley	Flax	Spring wheat	Corn	Oats	Barley	Flax	Spring wheat	Corn
MANAGEMENT GROUP 2—NEARLY LEVEL, GENTLY SLOPING OR GENTLY UNDULATING, WELL-DRAINED UPLAND LOAMY SOI												
Subgroup 2C:												
	A	22–25	25–28	17–19	6– 7	10–11	33–36	38–41	25–27	10–11	15–16	44–47
Ahnberg-Poinsett complex, gently un-	B	25–28	29–32	21–23	7– 8	12- 13	41–44	54–57	38–40	13–14	22–23	54–57
dulating.	C	23–26	27–30	19–21	7– 8	12–13	38–41	51–54	35–37	12–13	21–22	52–55
Poinsett silt loam, gently undulating	D	19–22	29–32	21–23	8– 9	13–14	42–45	52–55	36–38	15–16	25–26	58–61
Singsaas loam, gently undulating	E	23–26	34–37	26–28	8– 9	13–14	45–48	56–59	40–42	16–17	27–28	61–64
Subgroup 2D:												
	A	24–26	28–31	19–21	7– 8	11–12	35–37	40–43	27–29	10–11	16–17	46–48
	B	27–29	32–35	23–25	8– 9	13–14	43–45	56–59	44–46	13–14	23–24	56–58
Sinai silty clay loam, nearly level	C	25–27	30–33	21–23	8– 9	13–14	40–42	57–60	41–43	12–13	22–23	54–56
Sinai silty clay loam, gently sloping	D	21–23	32–35	23–25	9–10	14–15	44–46	54–57	38–40	15–16	26–27	60–62
	E	25–27	34–37	25–27	9–10	14–15	47–49	58–61	42–44	16–17	28–29	63–65
MANAGEMENT GROUP 3—UNDULATING OR SLOPING LOAMY UPLAND SOILS												
Subgroup 3A:												
	A	20–23	23–26	15–17	6– 7	9–10	31–34	36–39	24–26	9–10	14–16	42–45
Flandreau loam, deep over till, sloping	B	23–26	27–30	19–21	7– 8	10–11	39–42	52–55	37–39	11–12	20–22	52–55
Kranzburg silt loam, sloping	C	21–24	25–28	17–19	7– 8	10–11	36–39	49–52	34–36	10–11	19–21	50–53
Vienna loam, sloping	D	17–20	27–30	19–21	8– 9	11–12	40–43	50–53	35–37	13–14	22–24	56–59
	E	21–24	29–32	21–23	8– 9	11 12	43–46	54–57	39–41	14–15	24–26	59–62
Subgroup 3B:												
	A	20–23	23–26	15–17	6– 7	9–10	31–34	36–39	24–26	9–10	14–16	42–45
Ahnberg-Poinsett complex, undulating	B	23–26	27–30	19–21	7 8	10–11	39–42	52–55	37–39	11–12	20–22	52–55
Poinsett silt loam, undulating	C	21–24	25–28	17–19	7– 8	10–11	36–39	49–52	34–36	10–11	19–21	50–53
Singsaas loam, undulating	D	17–20	27–30	19–21	8– 9	11–12	40–43	50–53	35–37	13–14	22–24	56–59
	E	21–24	29–32	21–23	8– 9	11–12	43–46	54–57	39–41	14–15	24–26	59–62
Subgroup 3C:												
	A	20–23	23–26	15–17	6– 7	9–10	31–34	36–39	24–26	9–10	14–16	42–45
	B	23-26	27 30	19–21	7– 8	10–11	39–42	52–55	37–39	11–12	20–22	52–55
Sinai silty clay loam, sloping	C	21–24	25–28	17–19	7– 8	10–11	36–39	49–52	34–36	10–11	19–21	50–53
	D	17–20	27–30	19–21	8– 9	11–12	40–43	50–53	35–37	13–14	22–24	56–59
	E	21–24	29 32	21–23	8– 9	11–12	43–46	54–57	39–41	14–15	24–26	59–62
MANAGEMENT GROUP 4—ROLLING, THIN LOAMY SOILS												
Subgroup 4A:												
	A	6–11	7–12	5– 8	2– 3	3– 5	12–17	14–19	9–13	4– 5	6– 8	20–25
	B	7–12	9–14	7–10	3– 4	4– 6	16–21	22–27	14–18	5– 6	10–12	26–31
Buse complexes, rolling	C	6–11	8–13	6– 9	3– 4	4– 6	15 20	19–24	11–15	5– 6	9–11	24–29
	D	5–10	9–14	7–10	4– 5	4– 6	16–21	20–25	12–16	6– 7	12–14	26–31
	E	6–11	9–14	7–10	4– 5	4– 6	17–22	22–27	14–18	7– 8	13–15	27–32
Subgroup 4B:												
	A	6–11	7–12	5– 8	2– 3	3– 5	12–17	14–19	9–13	4– 5	6– 8	20–25
	B	7–12	9–14	7–10	3– 4	4– 6	16–21	22–27	14–18	5– 6	10–12	26–31
Buse stony complexes, rolling	C	6–11	9–13	6– 9	3– 4	4– 6	15–20	19–24	11–15	5– 6	9–11	24–29
	D	5–10	9–14	7–10	4– 5	4– 6	16–21	20–25	12–16	6– 7	12–14	26–31
	E	6–11	9–14	7–10	4– 5	4– 6	17–22	22–27	14–18	7– 8	13–15	27–32

TABLE 6.—*Yields of crops in bushels per acre—Brookings County, S.D.—Continued*

Subgroup and soils	System of management	Unfavorable growing conditions					Favorable growing conditions					Very f
		Corn	Oats	Barley	Flax	Spring wheat	Corn	Oats	Barley	Flax	Spring wheat	Corn
MANAGEMENT GROUP 5—COMPLEX SOIL AREAS												
Subgroup 5A:												
Poinsett-Buse-Pierce soils, gently undulating. Singsaas-Buse loams, gently undulating Vienna-Buse loams, gently undulating	A	19–22	22–25	15–17	5– 6	9–10	29–32	33–36	22–24	8– 9	13–14	39–41
	B	22–25	25–28	18–20	6– 7	10–11	36–39	47–50	33–35	10–11	19–20	48–51
	C	20–23	24–27	17–19	6– 7	10–11	33–36	44–47	30–32	9–10	18–19	46–49
	D	17–20	26–29	19–21	7– 8	11–12	37–40	45–48	31–33	12–13	21–22	51–54
	E	20–23	27–30	20–22	7– 8	11–12	40–43	50–53	36–38	13–14	23–24	54–57
Subgroup 5B:												
Buse complexes, undulating Buse stony complexes, undulating Poinsett-Buse-Pierce soils, undulating Singsaas-Buse loams, undulating Singsaas-Buse-Pierce loams, undulating Vienna-Buse loams, undulating Vienna-Buse-Pierce loams, undulating	A	15–18	17–20	11–13	4– 5	7– 8	24–27	28–31	19–21	7– 8	11–12	33–36
	B	18–21	21–24	15–17	5– 6	8– 9	32–35	44–47	32–34	8– 9	15–16	43–46
	C	16–19	20–23	14–16	5– 6	8– 9	30–33	41–44	29–31	8– 9	14–15	40–43
	D	13–16	21–24	15–17	6– 7	8– 9	32–35	40–43	28–30	9–10	17–18	43–46
	E	16–19	22–25	16–18	6– 7	8– 9	34–37	43–46	32–34	10–11	18–19	45–48
Subgroup 5C: Poinsett-Buse-Pierce soils, rolling Singsaas-Buse-Pierce loams, rolling Vienna-Buse-Pierce loams, rolling Vienna-Buse loams, steep	A	6–11	7–12	5– 8	2– 3	3– 5	12–17	14–19	9–13	4– 5	6– 8	20–25
	B	7–12	9–14	7–10	3– 4	4– 6	16–21	22–27	14–18	5– 6	10–12	26–31
	C	6–11	9–13	6– 9	3– 4	4– 6	15–20	19–24	11–15	5– 6	9–11	24–29
	D	5–10	9–14	7–10	4– 5	4– 6	16–21	20–25	12–16	6– 7	12–14	26–31
	E	6–11	9–14	7–10	4– 5	4– 6	17–22	22–27	14–18	7– 8	13–15	27–32
MANAGEMENT GROUP 6—SOILS WITH GRAVEL SUBSTRATUM												
Subgroup 6A:												
Estelline silt loam, nearly level Estelline silt loam, gently sloping Fordville loam, deep, nearly level	A	22–25	25–28	17–19	6– 7	10–11	33–36	38–41	25–27	9–10	15–16	44–47
	B	25–28	29–32	21–23	7– 8	12–13	41–44	54–57	38–40	12–13	22–23	54–57
	C	23–26	27–29	19–21	7– 8	12–13	38–41	51–54	35–37	11–12	21–22	52–55
	D	19–22	29–32	21–23	8– 9	13–14	42–45	52–55	36–38	14–15	25–26	58–61
	E	23–26	31–34	23–25	8– 9	13–14	45–48	56–59	40–42	15–16	27–28	61–64
Subgroup 6B:												
Athelwold silty clay loam, nearly level	A	24–26	28–30	18–20	7– 8	11–12	35–37	40–42	27–28	10–11	16–17	46–48
	B	27–29	32–34	22–24	8– 9	13–14	43–45	56–58	40–41	13–14	23–24	56–58
	C	25–27	30–32	20–22	8– 9	13–14	40–42	53–55	37–38	12–13	22–23	54–56
	D	21–23	32–34	22–24	9–10	14–15	44–46	54–56	38–39	15–16	26–27	60–62
	E	25–27	34–36	24–26	9–10	14–15	47–49	58–60	42–43	16–17	28–29	63–65
Subgroup 6C: Estelline silt loam, moderately shallow, nearly level. Estelline silt loam, moderately shallow, gently sloping. Fordville loam, nearly level Fordville loam, gently undulating Fordville loam, thick solum, nearly level	A	16–19	18–21	12–14	3– 5	7– 8	25–28	29–32	19–21	7– 8	12–13	34–37
	B	19–22	22–25	16–18	4– 6	8– 9	33–36	45–48	32–34	9–10	18–19	44–47
	C	17–20	21–24	15–17	4– 6	8– 9	31–34	42–45	29–31	8– 9	17–18	41–44
	D	14–17	22–25	16–18	5– 7	9–10	33–36	41–44	28–30	11–12	20–21	44–47
	E	17–20	23–26	17–19	5– 7	9–10	35–38	44–47	31–33	12–13	22–23	46–49
Subgroup 6D:												
Renshaw sandy loam, nearly level Renshaw sandy loam, gently sloping	A	0–11	8–13	5– 9	2– 3	3– 5	11–16	13–18	9–12	3– 5	5– 7	19–24
	B	0–12	10–15	7–11	3– 4	4– 6	15–20	21–26	14–17	4– 6	9–11	25–30
	C	0–11	9–14	6–10	3– 4	4– 6	14–19	18–23	11–14	4– 6	8–10	23–28
	D	0–10	10–15	7–11	4– 5	4– 6	15–20	19–24	12–15	5– 7	11–13	25–30
	E	0–11	10–15	7–11	4– 5	4– 6	16–21	21–26	14–17	6– 8	12–14	26–31

TABLE 6. — *Yields of crops in bushels per acre—Brookings County, S.D.—Continued*

Subgroup and soils	System of management	Unfavorable growing conditions					Favorable growing conditions					Very fa
		Corn	Oats	Barley	Flax	Spring wheat	Corn	Oats	Barley	Flax	Spring wheat	Corn
MANAGEMENT GROUP 7—SANDY SOILS												
Subgroup 7A:												
Egeland sandy loam, nearly level	A	16–19	18–21	12–14	4–5	7–8	25–28	29–32	19–21	7–8	12–13	34–37
Egeland sandy loam, gently undulating	B	19–22	22–25	16–18	5–6	8–9	33–36	45–48	32–34	9–10	18–19	44–47
Fordville sandy loam, nearly level	C	17–20	21 24	15–17	5–6	8–9	31–34	42–45	29–31	8–9	17–18	41–44
Fordville sandy loam, gently undulating	D	14–17	22–25	16–18	6–7	9–10	33–36	41–44	28–30	11–12	20–21	44–47
Hecla loam, undulating	E	17–20	23–26	17–19	6–7	9–10	35–38	44–47	31–33	12–13	22–23	46–49
Subgroup 7B:	A	15–18	17–20	11–13	4–5	7–8	24–27	28–31	19–21	7–8	11–12	33–36
Maddock sandy loam, nearly level	B	18–21	21–24	15–17	5–6	8–9	32–35	44–47	32–34	8–9	15–16	43–46
Maddock sandy loam, undulating	C	16 19	20–23	14–16	5–6	8–9	30–33	41–44	29–31	8–9	14–15	40–43
Hecla sandy loam, nearly level	D	13–16	21–24	15–17	6–7	8–9	32–35	40–43	28–30	9–10	17–18	43–46
	E	16–19	23–25	16–18	6–7	8–9	34–37	43–46	31–33	10–11	18–19	45–48
Subgroup 7C:												
Dickey sandy loam, gently undulating												
Dickey sandy loam, undulating	A	17–20	20–23	13–15	5–6	8–9	26–29	30–33	20–22	7–8	12–13	35–38
Egeland sandy loam, deep over loamy drift, nearly level.	B	20–23	24–27	17–19	6–7	9–10	34–37	46–49	33–35	9–10	18–19	45–48
	C	18–21	23–26	16–18	6–7	9–10	32–35	33–36	20–22	9–10	17–18	42–45
Egeland sandy loam, deep over loamy drift, gently undulating	D	15–18	25–28	18–20	7–8	10–11	36–39	45–48	32–34	11–12	20–21	47–50
	E	18–21	26–29	19–21	7–8	10–11	38–41	48–51	35–37	12–13	22–23	49–52
Vienna sandy loam, gently undulating												
Vienna sandy loam, undulating												
MANAGEMENT GROUP 8—POORLY DRAINED SOILS												
Subgroup 8A:												
	A	0–30	0–35	0–23	0–9	0–14	37–40	43–46	29–31	11–12	17–18	47–50
Volga loam, somewhat poorly drained, nearly level.	B	0–30	3–38	3–26	1–10	1–15	43–46	55–58	38–40	12–13	21–22	55–58
	C	0–30	3–38	3–26	1–10	1–15	43–46	52–55	35–37	12–13	20–21	55–58
Volga silty clay loam, somewhat poorly drained, nearly level.	D	0–30	4–39	4–27	2–11	1–15	45–48	55–58	38–40	13–14	23–24	57–60
	E	0–30	5–40	5–28	2–11	1–15	47–50	58–61	41–43	14–15	24–25	59–62
Subgroup 8B:												
Hidewood silty clay loam, nearly level	A	0–30	0–35	0–23	0–9	0–14	39–42	45–48	30–32	11–12	18–19	49–52
Lamoure silty clay loam, nearly level	B	0–30	3–38	3–26	1–10	1–15	45–48	57–60	39–41	12–13	22–23	57–60
Leota silty clay loam, nearly level	C	0 30	3–38	3–26	1–10	1–15	45–48	48–51	30–32	12–13	21–22	57–60
Oldham silty clay loam, nearly level	D	0–30	4–39	4–27	2–11	1–15	47–50	57–60	39–41	13–14	24–25	59–62
Tetonka silty clay loam, nearly level	E	0–30	5–40	5–28	2–11	1–15	49–52	60–63	42–44	14–15	25–26	61–64

[1] Soils in this subgroup may be saline, in which case all yields are drastically reduced. Salinity can be detected by a soil test.

tors that severely restrict yields, but that do not necessarily cause a complete crop failure.

Favorable growing conditions have no pronounced limitations caused by the amount and distribution of rainfall, adverse temperature, or any other factors that seriously interfere with crop production. Although there are no serious limitations in a favorable year, the growing conditions are not favorable enough to produce maximum yields.

Very favorable growing conditions represent those most desirable for plant growth in Brookings County. These conditions will occur not more than 15 to 20 percent of the time.

The growing conditions listed are interpreted in relation to the characteristics of each soil type. For example, a very favorable year for a well-drained upland soil may be unfavorable for a bottom-land soil because it is flooded or has a high water table. On the other hand, a very favorable year for a bottom-land soil may be unfavorable for a well-drained upland soil because of a scarcity of moisture in the well-drained soil.

Management systems used in yield prediction tables

Crop yield predictions are given in table 6 for five different systems of management (A, B, C, D, and E). Many more systems or combinations could be given, but these five are representative and basic, and each has an essential or distinctive characteristic that separates it from the others.

Under management system A, a corn and small grain cropping sequence is followed; legumes or commercial fertilizers are not used. Under this type of management, crop yields can be expected to decrease continually because of declining soil fertility. The yield estimates for this rotation can be compared easily to those of system B to determine what yield increases could be expected if commercial fertilizer is used.

In management system B, the nitrogen is obtained from commercial fertilizer and not from legumes. To obtain the yields listed for this system, 30 to 40 pounds of available nitrogen and 20 to 30 pounds of available phosphate (P_2O_5) are applied each year to the corn and to the small grain. In a favorable year, higher rates of commercial fertilizer profitably can be applied. In unfavorable years fertilizer seldom profitably increases yields.

In management system C, a sweetclover catch crop is used to obtain part of the nitrogen. As indicated by increases in crop yields shown in table 6, the amount of legume nitrogen obtained by this method is dependent on the rainfall and other weather conditions. Because most of the legume nitrogen is used by the following corn crop, 20 to 30 pounds of available nitrogen is applied to the small grain. In addition, 20 to 30 pounds of available phosphate is applied. The amount of nitrogen applied to the small grain is less than in system B, and the expected yields of small grain would be correspondingly lower. This proportion may vary somewhat, depending on how much growth the sweetclover made and its residual effect. The validity of these yield estimates depends greatly on the plowing of the sweetclover in the spring when it is 8 to 10 inches high. If it is allowed to grow much higher, moisture losses will be excessive and the subsequent corn yields may be materially decreased.

Management system D uses a stand-over legume that is allowed to grow for a hay or seed crop. If the legume is followed by corn in a dry year, the yields of corn may be seriously limited because of a scarcity of moisture in the subsoil. Considerably more nitrogen will be returned in this rotation than in system C, which uses a legume catch crop. Only phosphate fertilizer therefore is applied.

Management system E is a longer rotation and is more suitable for farms that have large numbers of livestock. Only 1 of the 2 years of corn immediately follows the legume. Therefore the reduction in yield due to depletion of subsoil moisture in a dry year is not so pronounced, because the corn yields given are an average for these 2 crop years. The small grain is in a position in the rotation where it will receive more nitrogen and more moisture than it would if it followed 2 years of corn. Proportionally higher yields are indicated in the table.

In the legume rotations, the yields in table 6 are given on the basis of a pure stand of legume. If grass is mixed with the legume, normally the total yield of forage is increased, but the nitrogen fixed in the soil is proportionately less and the yields of following crops are affected accordingly.

In attaining the estimated yields in table 6, it is assumed that only disease-resistant adapted varieties are used. Unadapted varieties may reduce the yield to such an extent that harvesting the grain would not pay.

The county agent, Soil Conservation Office, or South Dakota State College will supply additional information on fertilizers, rotations, and soil management.

Capability Classes and Subdivisions

The soils of Brookings County have been grouped into capability classes and subdivisions. In this system of classification, there are three categories—capability class, capability subclass, and capability unit. The capability unit consists of soils that are nearly uniform in use possibilities and management needs. Capability units that have the same kind and degree of permanent limitations make up capability subclasses. Capability subclasses that are alike in the general degree of permanent limitations make up a capability class.

Each capability class has a specified range in degree of hazard or limitation for permanent use; the subclass shows the kind of hazard or limitation; and the unit contains soils that need the same kind of management and conservation treatment. Each of these three capability groupings classifies soils according to their permanent limitations for use. Crop yields are not reflected in the land capability groupings, except in a general way. For example, Brookings silty clay loam,

nearly level, and Vienna loam, nearly level, are both in capability subclass IIc. Yet 9 bushels more of corn can be expected from the Brookings than from the Vienna soil under average management during a favorable year.

A capability classification is given to units of individual soils and to some complexes. Complexes, such as Poinsett-Buse-Pierce soils, undulating, that are composed of strongly contrasting units have split capability classifications. Poinsett-Buse-Pierce soils, undulating, is classified IIIe-VIe. This is because small knobs of thin Buse soils are interspersed in a landscape of deeper Poinsett soils, which occur on more gentle relief.

Capability classification of Brookings County soils[7]

Except for complexes that consist of soils of different capability classification, the soils and land types of Brookings County are placed in the following classes and subdivisions:

Class II—Land having moderate limitations or risks of damage; good all-around land.

- IIc: Limited by climate that is slightly too dry for maximum sustained production.
  - Brookings silty clay loam, nearly level.
  - Brookings silty clay loam, drainageways.
  - Flandreau silt loam, nearly level.
  - Flandreau loam, deep, nearly level.
  - Flandreau silt loam, deep, nearly level.
  - Flandreau loam, deep over till, nearly level.
  - Kranzburg silt loam, nearly level.
  - Kranzburg loam, nearly level.
  - Lismore silty clay loam, nearly level.
  - Lismore silty clay loam, drainageways.
  - Moody silt loam, nearly level.
  - Oak Lake silt loam, nearly level.
  - Oak Lake silty clay loam, drainageways.
  - Poinsett silt loam, nearly level.
  - Vienna loam, nearly level.
  - Waubay silty clay loam, nearly level.
  - Waubay silty clay loam, drainageways.
- IIe: Limited by moderate water erosion hazard.
  - Ahnberg-Poinsett complex, gently undulating.
  - Flandreau silt loam, gently sloping.
  - Flandreau loam, deep, gently undulating.
  - Flandreau loam, deep over till, gently sloping.
  - Kranzburg silt loam, gently sloping.
  - Kranzburg loam, gently sloping.
  - Moody silt loam, gently sloping.
  - Poinsett silt loam, gently undulating.
  - Sinai silty clay loam, nearly level.
  - Sinai silty clay loam, gently sloping.
  - Singsaas loam, gently undulating.
  - Vienna loam, gently sloping.
- IIs4: Limited by slight droughtiness caused by deep-lying gravel and coarse sand.
  - Athelwold silty clay loam, nearly level.
  - Estelline silt loam, nearly level.
  - Estelline silt loam, gently sloping.
  - Fordville loam, deep, nearly level.

Class III—Land having severe limitations or risks of damage; regular cultivation is possible if limitations are considered.

- IIIe: Limited by severe water-erosion hazard.
  - Ahnberg-Poinsett complex, undulating.
  - Flandreau loam, deep over till, sloping.
  - Kranzburg silt loam, sloping.
  - Poinsett silt loam, undulating.
  - Sinai silty clay loam, sloping.
  - Singsaas loam, undulating.
  - Vienna loam, sloping.
- IIIs2: Limited by a severe wind erosion hazard and low moisture capacity.
  - Dickey sandy loam, undulating.
  - Dickey sandy loam, gently undulating.
  - Egeland sandy loam, gently undulating.
  - Egeland sandy loam, nearly level.
  - Egeland sandy loam, deep over loamy drift, nearly level.
  - Egeland sandy loam, deep over loamy drift, gently undulating.
  - Fordville sandy loam, nearly level.
  - Fordville sandy loam, gently undulating.
  - Hecla loam, undulating.
  - Hecla sandy loam, nearly level.
  - Maddock sandy loam, undulating.
  - Maddock sandy loam, nearly level.
  - Vienna sandy loam, gently undulating.
  - Vienna sandy loam, undulating.
- IIIs4: Limited by droughtiness caused by moderately deep gravel and coarse sand.
  - Estelline silt loam, moderately shallow, nearly level.
  - Estelline silt loam, moderately shallow, gently sloping.
  - Fordville loam, nearly level.
  - Fordville loam, gently undulating.
  - Fordville loam, thick solum, nearly level.
  - Renshaw sandy loam, nearly level.
  - Renshaw sandy loam, gently sloping.

Class IV—Land having very severe limitations; suited to occasional cultivation or to some kind of limited cultivation.

- IVw: Limited by severe wetness.
  - Hidewood silty clay loam, nearly level.
  - Lamoure silty clay loam, nearly level.
  - Leota silty clay loam, nearly level.
  - Oldham silty clay loam, nearly level.
  - Tetonka silty clay loam, nearly level.
  - Volga loam, somewhat poorly drained, nearly level.
  - Volga silty clay loam, somewhat poorly drained, nearly level.

Class V—Land not suited for cultivation; has few limitations for grazing.

- Vw: Good hay or pasture land but too wet for cultivation.
  - Parnell silty clay loam, nearly level.
  - Solomon clay, nearly level.
  - Volga silty clay loam, poorly drained, nearly level.

[7] This system of land classification is used by the Soil Conservation Service for farm planning.

Class VI—Land not suited for cultivation; moderate limitations for grazing.
- VIe: Surface soil too thin or slopes too steep for productive cultivation.
  - Buse complexes, rolling.
  - Buse stony complexes, rolling.
  - Buse complexes, hilly.
  - Pierce complexes, hilly.
- VIs4: Soil underlain at a very shallow depth by coarse gravel and sand.
  - Sioux gravelly loam, gently undulating.
  - Terrace escarpments, sloping.

Class VIII—Land not suited for cultivation or grazing; suited for wildlife and recreation.
- VIIIw: Swampy lands.
  - Rauville silty clay loam, nearly level.
  - Marsh.

The classification of a complex that is composed of soils with different capability classification depends upon the classification of the soils that compose the complex and the percentage of the soils in the complex. A classification of the complexes with dual classification follows.

Composed of 75 percent IIe and 25 percent VIe soils:
- Poinsett-Buse-Pierce soils, gently undulating.
- Singsaas-Buse loams, gently undulating.
- Vienna-Buse loams, gently undulating.

Composed of 65 percent IIIe and 35 percent VIe soils:
- Buse complexes, undulating.
- Buse stony complexes, undulating.
- Poinsett-Buse-Pierce soils, undulating.
- Singsaas-Buse loams, undulating.
- Singsaas-Buse-Pierce loams, undulating.
- Vienna-Buse loams, undulating.
- Vienna-Buse-Pierce loams, undulating.

Composed of 45 percent IIIe and 55 percent VIe soils:
- Poinsett-Buse-Pierce soils, rolling.
- Singsaas-Buse-Pierce loams, rolling.
- Vienna-Buse-Pierce loams, rolling.
- Vienna-Buse loams, steep.

Engineering Applications[8]

The purpose of this section is to give helpful information to engineers and others whose work is related to engineering. Because soils are nonhomogeneous, a survey of this type cannot be used to obtain data for final design, but the information will aid in such work as preliminary planning. Data for final design should be obtained from observations and tests at the particular site involved.

The most important parts of this soil survey report for engineering information are this section, the soil maps, Descriptions of Soil Series and Soil Mapping Units, General Nature of the Area, Genesis and Morphology, and General Soil Areas of Brookings County. However, a study of all parts should be valuable.

[8] This section was written by N. E. BERGSTRESER, assistant professor of civil engineering, South Dakota State College.

Terminology

Soil scientists and other agricultural workers use some terms that differ in meaning from those used by engineers. Some terms used by agriculturists are not used by engineers and vice versa. Because this report may be read by different groups of people, some procedure in use of terminology must be specified. The terminology of soil science is used in other parts of this report and will be used in this part wherever applicable. A glossary of agricultural terms (pp. 85–86) and a glossary of engineering terms (pp. 83–84) are included in the report.

The term "soil" may be particularly confusing. The term "soil" means to agriculturists what the term "soil profile" means to engineers. Agriculturists think of a soil as a natural body made up of different horizons that have some different characteristics. Engineers single out each horizon as a different soil. What engineers call soil is called a soil material by agriculturists. To conform with the agriculturists, the material in each horizon of a profile will be called a soil material in the engineering section.

The following terms in the Glossary of Agricultural Terms may be confusing to those not accustomed to the terminology of soil science: clay, granular, profile, sand, silt, soil, soil class, soil separates, structure, texture, and type.

Sampling and Test Data

The soils were sampled for engineering tests by use of a 3½-inch auger of the core type. At each sampling site the soil materials were sampled to a depth of 5 feet. All sites where soils were sampled for engineering tests were within a few feet of the sites where soils were sampled for agricultural tests. Soil materials were sampled by natural horizons and in most cases at the same depth intervals for both agricultural and engineering tests.

In order to classify the soil materials in accordance with the engineering classification systems used, data were needed on the mechanical analysis, liquid limit, plastic limit, and content of organic matter.

The liquid-limit and plastic-limit tests measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a solid to semisolid or plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a solid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and plastic limit. This index indicates the range of moisture content within which a soil material is plastic.

The data obtained in the agricultural tests for organic matter were used as engineering data. These data are expressed as percentage of organic matter by weight of soil. The data of the mechanical analysis

in the agricultural tests were also used. The agricultural data are based on only the material passing a No. 10 U. S. standard sieve, however, or material smaller than 2 millimeters. It was therefore necessary to determine not only the percentage passing the No. 10 sieve but, on the basis of total sample, the percentage passing the No. 4 sieve as well.

The samples were prepared for testing, and the percentage of soil material passing the No. 4 and No. 10 sieves was determined at the Civil Engineering Soils Testing Laboratory of the South Dakota State College. Tests for plastic limit and liquid limit were made at the Soils Testing Laboratory of the South Dakota State Highway Commission.

Geology

This subsection supplements Geology and Physical Geography, which describes the surface geology in Brookings County.

The complete geologic history of the area in which Brookings County is located is not so well established as that of many other areas. It is thought that the marine Cretaceous bedrock of Brookings County may be overlain by at least 100 to 150 feet of glacial deposits. In a well boring at De Smet in Kingsbury County bedrock occurred at 104 feet, but a boring near Bryant in Hamlin County ended at a depth of 320 feet without reaching bedrock. These data suggest that the bedrock beneath the drift may have considerable relief.

Several of the Wisconsin drift sheets covered all or parts of Brookings County. It is thought that several pre-Wisconsin deposits occur below the Wisconsin drift sheets, but none of these deposits have been positively identified. For this report, valuable information from unrecorded well borings made in Brookings County was obtained from local sources.[9] Flint's study (*2*) is the primary published reference on geology used for this report.

Some general characteristics of the glacial deposits in the county are important. The clay content of the till is relatively high, and much of the sand and gravel is of relatively low durability and strength. These characteristics indicate that the till in the area originally was derived largely from the underlying bedrock. The sand and gravel in Brookings County generally has little fine material that passes the No. 80 sieve and is retained on the No. 200 sieve. This observation, however, is approximate and may not hold true for a particular deposit.

The general profile in Brookings County consists of about 30 to 60 feet of Wisconsin drift overlying the pre-Wisconsin deposits. The color of the Wisconsin deposits is generally yellow to brown. At 30 to 60 feet below ground surface, usually a dark-blue glacial till occurs. This till is quite plastic and stiff. The dark-blue color is thought to result from clay that originated from the Cretaceous bedrock. From well boring, it is known that the blue till extends to depths of at least 100 to 150 feet. The information from well boring did not include depths greater than 150 feet.

The profile that occurs at a particular location may be similar to the general profile, or, as is typical of glacial deposits, it may show some deviation. Some of these deviations in the county are the occurrence of sand and gravel lenses, layers of gray silt, and layers of green till. Some of the bedrock that underlies the glacial deposits consists of the following parts, in order from top of bedrock down: Pierre shale, Niobrara chalk, Carlisle shale, Greenhorn limestone, Graneros shale, Dakota sandstone, Fuson shale, Lakota sandstone. The thickness of different layers of bedrock may vary from about 20 feet to several hundred feet.

Sand and gravel deposits that are likely to be important occur within the outwash areas that are shown on the General Soil Area Map. The depths of most of the deposits are not known. Some depths are about 20 feet, but some are much greater and others are less. Because the prevailing winds were from the west at the time of the last deglaciation, there are many deposits of relatively fine sand on the eastern sides of outwash areas.

The gravel in Brookings County is reasonably satisfactory for portland-cement concrete and for bituminous paving mixtures. Pit-run gravel has been used satisfactorily for bituminous paving and base courses of city streets in the county, and washed pit-run gravel and sand is used extensively for portland-cement concrete. The addition of rock is desirable in some cases.

Mapping Units and the Soil Map

As used in this report the term "soil type" does not have the same meaning that it has in many engineering papers. In the classification system used in soil science, type refers to a particular profile. The profiles of the soils mapped for this report are classified according to their series, type, and phase. The symbols of most mapping units represent a phase of a type in a series. An example of a series is Poinsett, which indicates a certain profile description. An example of a type is Poinsett silt loam, which has the same general profile as any Poinsett soil and the further requirement that its plow-depth layer is silt loam. An example of a phase is Poinsett silt loam, nearly level, which indicates the additional factor of slope. Phases of types may also be given in such terms as stony, till substratum, and eroded.

The soil map in this report shows the areal extent of the soil mapping units. In using the soil map it should be remembered that the lines separating soil units do not represent abrupt changes in profile. Normally there is a transition area between units. The profile in transition areas is generally unpredictable, but an approximate classification can be made through a study of material on either side of the transition area. Some transitions may be relatively smooth and gradual, whereas others may involve a horizontal and vertical fingering of the horizons on either side of the transition. A transition between phases of the same

[9] DONALD RUST of Brookings, South Dakota, supplied information on observations of material encountered in boring wells to depths of about 100 to 150 feet.

soil type tends to be smooth and gradual. A transition between types in the same series tends to be somewhat predictable. In the lower categories of soil classification, the most unpredictable transition is between different soil series.

The legend of the soil map lists the symbols of the mapping units. Other symbols represent topographic features. The closed irregular figures represent the areal extent of the mapping units. The mapping unit symbol appears at one or more places inside each closed figure, or near the closed figure with a line extending to it.

Engineering Classification and Properties of Soils

The soil materials were classified according to two engineering classification systems: (1) The unified soil classification system as described in Technical Memorandum No. 3-357, Corps of Engineers, U. S. Army (*9*); and (2) the Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, Part 1, A.A.S.H.O. Designation: M145-49 (*1*). Table 7 contains the classification and engineering properties of the soil types. The estimate of engineering properties was taken from Technical Memorandum No. 3-357, Corps of Engineers, U. S. Army (*9*). This information is intended to be used as a guide in such work as preliminary planning. Final designs generally should be based on tests and observations of the particular soil materials involved.

A brief explanation of the data in each column of table 7 follows.

Horizon.—Symbols identifying each horizon.

Depths.—Depth intervals of the different horizons in the profile.

Thickness range.—Where known, the expected range of horizon thickness.

Color (Moist).—Color of soil when moist.

USDA (*Textural class*).—United States Department of Agriculture textural classification (*6*).

USDA (*percent passing No. 10 sieve*).—Percentage of the total soil material that passes a No. 10 U. S. standard sieve. This information is needed in estimating the grain-size distribution.

A.A.S.H.O.—Classification of the soil materials according to the American Association of State Highway Officials Designation: M145-49 (*1*).

Unified.—Classification of the soil materials according to the unified soil classification system as described in Technical Memorandum No. 3-357, Corps of Engineers, U. S. Army (*9*).

Value for embankments.—Suitability for use in embankments from the standpoint of strength and permeability.

Permeability.—Range of permeability values to be expected from the soil material for conditions ranging from undisturbed densities to compacted densities.

Compaction: Characteristics and recommended equipment.—When moisture conditions and thickness of lift are properly controlled, an appropriate number of passes with the equipment listed usually gives the desired densities. For OL, MH, CH, and OH type of soil materials (*9*) rubber-tired rollers may be advisable, particularly when moisture content is higher than optimum.

Standard A.A.S.H.O. maximum unit dry weight.—Unit dry weights for compacted soil materials at optimum moisture content for standard A.A.S.H.O. compactive effort.

Value for foundation material.—Very general statements of value as a foundation material. A soil material may be suitable for one kind of foundation but not another.

Requirements for seepage control.—Provisions needed, if any, for seepage control for foundations or earth embankments.

Value as foundation not subject to frost action.—Value as subgrade or subbase material when not subject to frost action.

Value as base under bituminous pavement.—Value of the soil material when used as a base course directly under bituminous paving.

Potential frost action.—An indication of the degree of frost action if water is present and freezing temperatures occur.

Compressibility and expansion.—An indication of compression and rebound under both long- and short-time loads. The qualities contributing to the effects of long-time loads and the effects of short-time loads are not identical but are somewhat parallel.

Drainage characteristics.—An indication of the degree to which the soil material used as a subgrade, subbase, or base will drain if adequate drainage features are provided.

Recommended compaction equipment.—When moisture conditions and thickness of lifts are properly controlled, a reasonable number of passes with the equipment listed usually produces the required densities.

Modified A.A.S.H.O. maximum unit dry weight.—Unit dry weights for soil materials compacted at optimum moisture content with the modified A.A.S.H.O. compactive effort.

Field CBR.—Typical range of California Bearing Ratio values for the soil material when compacted to the pertinent requirements.

Subgrade modulus.- Typical values of subgrade modulus for the soil material when compacted to the pertinent requirement.

It should be pointed out that the engineering properties given in table 7 for the soil materials are not based on the material being located in the profile shown. The properties given are for the soil materials of a horizon when used by themselves or in typical locations in engineering works.

All test data, horizon data, and classification data in the agricultural and engineering sections of this report are the results of the sampling and testing of single soil profiles, which are thought to represent the typical profile for the type named. In making the A.A.S.H.O. classification, the group and group index (*1*) were determined for a single set of data from a soil material in a typical profile. This classification then must be considered a typical value.

The Unified classification was arrived at in approxi-

TABLE 7.—*Classification and engineering*
[Explanation of

Horizon	Depths	Thickness range	Color (moist)	Classification: USDA[6] Textural class	Classification: USDA[6] Percent passing #10 sieve	Classification: A.A.S.H.O.	Classification: Unified	Value for embankments	Permeability	Compaction; Characteristics and recommended equipment	Standard A.A.S.H.O. maximum unit dry weight	Value for foundation material	Requirements for seepage control
ESTELLINE													
	Inches	*Inches*							*Cm. per sec.*		*Lb. per cu. ft.*		
A_1	0–8	6–12	Black	Silt loam	99	A–7–6(12)	OL[1]	Not suitable	10^{-4}–10^{-6}	Fair to poor. Sheepsfoot roller.	80–100	Fair to poor bearing; may have excessive settlement.	None
B_{21}	8–18	13–25	Dark gray to very dark brown.	Silt loam	99	A–7–6(16)	OL or OH [2]	Not suitable	10^{-5}–10^{-7}	Poor to very poor. Sheepsfoot roller.	70–100	Very poor bearing.	None
B_{22}	18–32		Dark grayish brown.	Silt loam	100	A–7–6(16)	OL or OH [3]	Not suitable	10^{-5}–10^{-7}	Same	70–100	Same	None
C_{ca}	32–48	10–20	Grayish brown.	Silt loam	99	A–6(11)	CL	Stable; use for impervious cores and blankets.	10^{-6}–10^{-8}	Fair to good. Sheepsfoot roller; rubber tired.	95–120	Good to poor bearing.	None
C–D	48–54	0–10	Same	Sandy loam	50	A–1–b(0)	SM	Fairly stable; not particularly suited to shells, but may be used for impervious cores or dikes.	10^{-3}–10^{-6}	Good with close control of moisture. Rubber-tired; sheepsfoot roller.	110–125	Same	Upstream blanket and toe drainage or wells.
D_1	54–60	----------	Multi-colored basic color brown.	Sandy loam	50	A1–b(0)	SM	Same	10^{-3}–10^{-6}	Same	110–125	Same	Same
FORDVILLE													
A_{1p}	0–6	----------	Black	Sandy loam.	99	A–6(3)	OL or SC[4,5]	May be fairly stable; use for impervious core for flood control structures.	10^{-5}–10^{-7}	Fair to poor. Sheepsfoot roller; rubber-tired.	90–110	Fair to poor; may have excessive settlement.	None
B_{21}	6–11	----------	Very dark grayish brown.	Sandy loam.	100	A–6(5)	CL or SC [5]	Fairly stable; use for impervious cores and blankets.	10^{-6}–10^{-7}	Fair. Sheepsfoot roller; rubber-tired.	100–125	Good to poor bearing.	None
B_{22}	11–19	2–8	Same	Sandy loam.	100	A–6(4)	Cl or SC [5]	Same	10^{-6}–10^{-8}	Same	100–125	Same	None
C	19–28½	3–20	Dark grayish brown.	Sandy loam.	99	A–4(3)	Cl or SC [5]	Same	10^{-6}–10^{-8}	Same	100–125	Same	None
D_1	28½–31	----------	Very dark grayish brown.	Loamy sand.	82	A–1–b(0)	SM	Fairly stable; not particularly suited to shells, but may be used for impervious cores or dikes.	10^{-3}–10^{-6}	Good, but needs close control of moisture. Rubber-tired; sheepsfoot roller.	100–125	Good to poor bearing value, depending on density.	Upstream blanket and toe drainage or wells.

properties of important soil types
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SILT LOAM

Value as foundation not subject to frost action	Value as base under bituminous pavement	Potential frost action	Compressibility and expansion	Drainage characteristics	Recommended compaction equipment, in order of preference	Modified A.A.S.H.O. maximum unit dry weight	Field CBR	Subgrade modulus K
						Lb. per cu. ft.		*Lb. per cu. in.*
Poor	Not suitable	Medium to high	Medium to high	Poor	Rubber-tired; sheepsfoot roller	90–105	4–8	100–200
Poor to very poor	Not suitable	Medium to high	High	Practically impervious.	Sheepsfoot roller; rubber-tired	85–105	3–8	75–150
Poor to very poor	Not suitable	Medium to high	High	Same	Sheepsfoot roller; rubber-tired	85–105	3–8	75–150
Fair to poor	Not suitable	Medium to high	Medium	Same	Sheepsfoot roller; rubber-tired	100–125	5–15	100–200
Good	Poor	Slight to high	Very slight	Fair to poor	Rubber-tired; sheepsfoot roller. Needs close control of moisture.	120–135	20–40	200-300
Good	Poor	Slight to high	Very slight	Fair to poor	Same	120–135	20–40	200–300

SANDY LOAM

Fair to poor	Not suitable	Medium to high	Medium to high	Poor	Rubber-tired; sheepsfoot roller	95–120	7–14	150–250
Fair	Not suitable	Medium to high	Medium	Practically impervious.	Rubber-tired; sheepsfoot roller	100 130	8–18	150–250
Fair	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–130	8–18	150–250
Fair	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–130	8–18	150–250
Good	Poor	Slight to high	Very slight	Fair to poor	Rubber-tired; sheepsfoot roller. Needs close control of moisture.	120–135	20–40	200–300

TABLE 7.—*Classification and engineering*

Horizon	Depths	Thickness range	Color (moist)	Classification: USDA [6]: Textural class	Classification: USDA [6]: Percent passing #10 sieve	Classification: A.A.S.H.O.	Classification: Unified	Characteristics pertinent to embankments and foundations: Value for embankments	Permeability	Compaction; Characteristics and recommended equipment	Standard A.A.S.H.O. maximum unit dry weight	Value for foundation material	Requirements for seepage control
	Inches	*Inches*							*Cm. per sec.*		*Lb. per cu. ft.*		
D_{ca}	31–55		Light brownish gray; lime crusts.	Sand and gravel.	82	A-1-b(0)	SM	Same	10^{-3}–10 ^{6}	Same	100–125	Same	Same
D_2	55–60		Light brownish gray.	Sand and gravel.	82	A-1-b(0)	SM	Same	10^{-3}–10^{-6}	Same	100–125	Same	Same
HECLA													
A_{1p}	0–7	8–14	Black	Sandy loam.	100	A-2-4(0)	SM–SC [6]	Fairly stable; may be used for impervious cores or dikes for flood-control structures.	10^{-4}–10^{-7}	Good to fair with close control of moisture. Rubber-tired; sheepsfoot roller.	105–125	Good to poor bearing value depending on density.	None to upstream blanket and tow drainage or wells.
A_1	7–12	8–14	Black	Sandy loam.	100	A-2-4(0)	SM–SC [6]	Same	10^{-4}–10^{-7}	Same	105–125	Same	Same
B_2	12–17	4–10	Black	Sandy loam.	100	A-2-4(0)	SM–SC [6]	Same	10^{-4}–10^{-7}	Same	105–125	Same	Same
C_1	17–42		Very dark grayish brown.	Loamy sand.	100	A-2-4(0)	SM	Fairly stable; not particularly suited to shells, but may be used for impervious cores or dikes.	10^{-3}–10^{-6}	Good with close control of moisture. Rubber-tired; sheepsfoot roller.	110–125	Same	Upstream blanket and toe drainage or wells.
C_1–D_1	42–48		Dark grayish brown.	Loamy sand.	100	A-2-4(0)	SM	Same	10^{-3}–10^{-6}	Same	110–125	Same	Same
D_1	48–54		Same	Sandy loam	100	A-6(9)	CL	Stable; impervious cores and blankets.	10^{-6}–10^{-8}	Fair to good. Sheepsfoot roller; rubber-tired.	95–120	Good to poor bearing.	None
D_2	54-60		Very dark grayish brown.	Loam	100	A-6(9)	CL	Same	10^{-6}–10^{-8}	Same	95–120	Same	None
KRANZBURG SILT LOAM:													
A_{1p}	0–8		Very dark brown.	Silt loam	100	A-7-6(13)	OL [7]	Not suitable	10^{-4}–$1^{-}0^{6}$	Fair to poor. Sheepsfoot roller.	80–100	Fair to poor bearing; may have excessive settlement.	None
B_{21}	8–11		Very dark grayish brown.	Silty clay loam.	100	A-7-6(16)	OL or OH [8]	Not suitable	10^{5-}–10^{-7}	Poor to very poor. Sheepsfoot roller.	70–100	Very poor bearing.	None
B_{22}	11–15		Same	Same	100	A-7-6(15)	CL	Stable; impervious cores or blankets.	10^{-6}–10^{-8}	Fair to good. Sheepsfoot roller; rubber-tired.	95–120	Good to poor bearing.	None
B_{23}	15–26		Dark grayish brown.	Same	100	A-7-6(13)	CL	Same	10^{-6}–10^{-8}	Fair to poor. Sheepsfoot roller or rubber-tired equipment.	95–120	Same	None

properties of important soil types—Continued

Characteristics pertinent to roads and airfield								
Value as foundation not subject to frost action	Value as base under bituminous pavement	Potential frost action	Compressibility and expansion	Drainage characteristics	Recommended compaction equipment, in order of preference	Modified A.A.S.H.O. maximum unit dry weight	Field CBR	Subgrade modulus K
						Lb. per cu. ft.		*Lb. per cu. in.*
Good	Poor	Slight to high	Very slight	Fair to poor	Same	120–135	20–40	200–300
Good	Poor	Same	Very slight	Fair to poor	Same	120–135	20–40	200–300
SANDY LOAM								
Fair to good	Poor to not suitable.	Slight to high	Slight to medium	Poor	Rubber-tired; sheepsfoot roller. Needs close control of moisture.	110–130	15–30	200–300
Fair to good	Poor to not suitable.	Slight to high	Slight to medium	Poor	Same	110–130	15–30	200–300
Fair to good	Poor to not suitable.	Slight to high	Slight to medium	Poor	Same	110–130	15–30	200–300
Good	Poor	Slight to high	Very slight	Fair to poor	Same	120–135	20–40	200–300
Good	Poor	Slight to high	Very slight	Fair to poor	Same	120–135	20–40	200–300
Fair to poor	Not suitable	Medium to high	Medium	Practically impervious.	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
EAST OF SIOUX RIVER								
Poor	Not suitable	Medium to high	Medium to high	Poor	Rubber-tired; sheepsfoot roller	90–105	4–8	100–200
Poor to very poor	Not suitable	Medium to high	High	Practically impervious.	Sheepsfoot roller; rubber-tired	85–105	3–8	75–120
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200

TABLE 7.—*Classification and engineering*

Horizon	Depths	Thickness range	Color (moist)	Classification: USDA[6]: Textural class	Classification: USDA[6]: Percent passing #10 sieve	Classification: A.A.S.H.O.	Classification: Unified	Characteristics pertinent to embankments and foundations: Value for embankments	Permeability	Compaction; Characteristics and recommended equipment	Standard A.A.S.H.O. maximum unit dry weight	Value for foundation material	Requirements for seepage control
	Inches	*Inches*							*Cm. per sec.*		*Lb. per cu. ft.*		
$C D_{ca}$[9]	26–28		Grayish brown.	Loam									
D_{ca}	28–46		Same	Loam	93	A-6(8)	CL or SC	Fairly stable; use for impervious cores and blankets.	10^{-6}–10^{-8}	Fair. Sheepsfoot roller; rubber-tired.	100–125	Same	None
D	46–60		Same	Clay loam	92	A-6(11)	CL	Stable; impervious cores and blankets.	10^{-6}–10^{-8}	Fair to good. Rubber-tired; sheepsfoot roller.	95–120	Same	None
KRANZBURG SILT LOAM:													
A_{1p}	0–5½		Black	Silt loam	100	A-7-6(14)	OL or OH[10]	Not suitable	10^{-5}–10^{-7}	Poor to very poor. Sheepsfoot roller.	70–100	Very poor bearing.	None
B_1	5½–9½	8–14	Very dark gray.	Silt loam	100	A 7-6(16)	OL or OH[10]	Not suitable	10^{-5}–10^{-7}	Same	70–100	Same	None
B_{21}	9½–14		Same	Silt loam	100	A-7-6(16)	OL or OH[10]	Not suitable	10^{-5}–10^{-7}	Same	70–100	Same	None
B_{22}	14–30	14–20	Dark grayish brown.	Silt loam	99	A-7-6(15)	CL	Stable; impervious cores and blankets.	10^{-6}–10^{-8}	Fair to good. Sheepsfoot roller; rubber-tired.	95–120	Good to poor bearing.	None
D_{ca}	30–46		Dark grayish brown and white.	Loam	93	A-6(12)	CL	Same	10^{-6}–10^{-8}	Same	95–120	Same	None
D	46–60		Same	Clay loam	95	A-6(11)	CL	Same	10^{-6}–10^{-8}	Same	95–120	Same	None
LAMOURE SILTY													
A_{10}	0–1		Black	Silty clay loam.			OH[11]	Not suitable	10^{-6}–10^{-10}	Poor to very poor. Sheepsfoot roller.	65–100	Very poor bearing.	None
A_{11}	1–7	12–24	Black	Silt loam	100	A-7-5(20)	OH[12]	Not suitable	10^{-6}–10^{-8}	Same	65–100	Same	None
B_{2g1}	7–16		Black	Silt loam	100	A-7-6(20)	OH[13]	Not suitable	10^{-6}–10^{-8}	Same	65–100	Same	None
B_{2g2}	16–33	6–20	Very dark gray.	Silty clay loam.	100	A-7-6(20)	OH[13]	Not suitable	10^{-6}–10^{-8}	Same	65–100	Same	None
C	33–48	6–30	Same	Same	100	A-7-6(20)	OH[14]	Not suitable	10^{-6}–10^{-8}	Same	65–100	Same	None
C_g	48–60		Gray	Silt loam	100	A-6(14)	CL	Stable; impervious cores and blankets.	10^{-6}–10^{-8}	Fair to good. Sheepsfoot roller; rubber-tired.	95–120	Good to poor bearing.	None
MADDOCK													
A_{1p}	0–8	8–14	Black	Sandy loam.	100	A-2-6(0)	SC[15]	Fairly stable; use for impervious core for flood-control structures.	10^{-6}–10^{-8}	Fair. Sheepsfoot roller; rubber-tired.	105–125	Good to poor bearing value.	None
B_2	8–21	4–14	Very dark gray.	Loamy sand.	100	A-2-6(0)	SC[15]	Same	10^{-6}–10^{-8}	Same	105–125	Same	None

properties of important soil types—Continued

Characteristics pertinent to roads and airfield								
Value as foundation not subject to frost action	Value as base under bituminous pavement	Potential frost action	Compressibility and expansion	Drainage characteristics	Recommended compaction equipment, in order of preference	Modified A.A.S.H.O. maximum unit dry weight	Field CBR	Subgrade modulus K
						Lb. per cu. ft.		*Lb. per cu. in.*
Fair	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–130	8–18	150–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
West of Sioux River								
Poor to very poor	Not suitable	Medium to high	High	Practically impervious.	Sheepsfoot roller; rubber-tired	85–100	3–8	75–150
Poor to very poor	Not suitable	Medium to high	High	Same	Sheepsfoot roller; rubber-tired	85–100	3–8	75–150
Poor to very poor	Not suitable	Medium to high	High	Same	Sheepsfoot roller; rubber-tired	85–100	3–8	75–150
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Clay Loam								
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	80–105	3–5	50–100
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	80–105	3–5	50–100
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	80–105	3–5	50–100
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	80–105	3–5	50–100
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	80–105	3–5	50–100
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Sandy Loam								
Fair to good	Not suitable	Slight to high	Slight to medium	Poor to practically impervious.	Rubber-tired equipment; sheepsfoot roller.	105–130	10–20	200–300
Fair to good	Not suitable	Slight to high	Slight to medium	Same	Same	105–130	10–20	200–300

TABLE 7.—*Classification and engineering*

Horizon	Depths	Thickness range	Color (moist)	Classification: USDA [6]: Textural class	Classification: USDA [6]: Percent passing #10 sieve	Classification: A.A.S.H.O.	Classification: Unified	Characteristics pertinent to embankments and foundations: Value for embankments	Permeability	Compaction; Characteristics and recommended equipment	Standard A.A.S.H.O. maximum unit dry weight	Value for foundation material	Requirements for seepage control
									Cm. per sec.		*Lb. per cu. ft.*		
C_1	21–48	20–40	Same	Sand	100	A–2–4(0)	SM-SC	Fairly stable; may be used for impervious core or dikes of flood-control structures.	10^{-4}–10^{-7}	Good to fair with close control of moisture. Rubber-tired; sheepsfoot roller.	105–125	Good to poor bearing value, depending on density.	None to upstream blanket and toe drainage or wells.
C_{ca}	48–60		Dark grayish brown.	Loamy sand.	97	A–2–4(0)	SC	Fairly stable; use for impervious core for flood-control structures.	10^{-6}–10^{-8}	Fair. Sheepsfoot roller; rubber-tired.	105–125	Good to poor bearing value.	None.
OAK LAKE													
A_{1p}	0–7		Black	Silt loam	100	A–7–6(17)	OL or OH [16]	Not suitable	10^{-5}–10^{-7}	Poor to very poor. Sheepsfoot roller.	70–100	Very poor bearing.	None
A_1B_{2ca}	7–11		Black and grayish brown.	Loam	100	A–7–6(15)	OL or OH [17]	Not suitable	10^{-5}–10^{-7}	Same	70–100	Same	None
B_{2ca} C_{ca}	11–20		Very dark grayish brown and dark grayish brown.	Loam	100	A–7–6(14)	OL [18]	Not suitable	10^{-4}–10^{-6}	Fair to poor. Sheepsfoot roller.	80–100	Fair to poor bearing; may have excessive settlement.	None
C_{ca} B_{2ca}	20–25		Very dark grayish brown and light olive brown.	Clay loam.	89	A–6(10)	CL	Stable; impervious cores and blankets.	10^{-6}–10^{-8}	Fair to good. Sheepsfoot roller; rubber-tired.	95–120	Good to poor bearing.	None
C_{ca}	25–40		Olive brown, white, and yellowish brown.	Clay loam.	89	A–6(10)	CL	Same	10^{-6}–10^{-8}	Same	95–120	Same	None
C	40–60		Light olive brown, gray, and yellowish brown.	Loam	89	A–6(8)	CL	Same	10^{-6}–10^{-8}	Same	95–120	Same	None
OLDHAM SILTY													
A_{10}	0–9		Black	Silty clay loam.	100	A–7–6(20)	OH [19]	Not suitable	10^{-6}–10^{-8}	Poor to very poor. Sheepsfoot roller.	65–100	Very poor bearing.	None
A_{11}	9–14		Black	Same	100	A–7–6(20)	OH [20]	Not suitable	10^{-6}–10^{-8}	Same	65–100	Same	None
B_{2gca}	14–38		Black and white.	Same	99	A–7–6(18)	OL or OH [21]	Not suitable	10^{-5}–10^{-7}	Same	70–100	Same	None

properties of important soil types—Continued

Characteristics pertinent to roads and airfield								
Value as foundation not subject to frost action	Value as base under bituminous pavement	Potential frost action	Compressibility and expansion	Drainage characteristics	Recommended compaction equipment, in order of preference	Modified A.A.S.H.O. maximum unit dry weight	Field CBR	Subgrade modulus K
						Lb. per cu. ft.		*Lb. per cu. in.*
Fair to good	Poor to not suitable.	Slight to high	Slight to medium	Poor	Rubber-tired equipment; sheepsfoot roller. Needs close control of moisture.	110–130	15–30	200–300
Fair to good	Not suitable	Slight to high	Slight to medium	Poor to practically impervious.	Rubber-tired equipment; sheepsfoot roller.	105–130	10–20	200–300
SILT LOAM								
Poor to very poor	Not suitable	Medium to high	High	Practically impervious.	Sheepsfoot roller; rubber-tired	85–105	3–8	75–150
Poor to very poor	Not suitable	Medium to high	High	Same	Sheepsfoot roller; rubber-tired	85–100	3–8	75–150
Poor	Not suitable	Medium to high	Medium to high	Poor	Rubber-tired; sheepsfoot roller	90–105	4–8	100–200
Fair to poor	Not suitable	Medium to high	Medium	Practically impervious.	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
CLAY LOAM								
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	80–105	3–5	50–100
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	80–105	3–5	50–100
Poor to very poor	Not suitable	Medium to high	High	Same	Sheepsfoot roller; rubber-tired	85–105	3–8	75–100

TABLE 7.—*Classification and engineering*

Horizon	Depths	Thickness range	Color (moist)	Classification: USDA[6]: Textural class	Classification: USDA[6]: Percent passing #10 sieve	Classification: A.A.S.H.O.	Classification: Unified	Characteristics pertinent to embankments and foundations: Value for embankments	Permeability	Compaction; Characteristics and recommended equipment	Standard A.A.S.H.O. maximum unit dry weight	Value for foundation material	Requirements for seepage control
									Cm. per sec.		*Lb. per cu. ft.*		
C_{gca}	38–60	----------	Very dark grayish brown and white.	Clay loam	100	A-7-6(18)	CL or CH	Fair stability with flat slopes. Thin cores, blankets, and dike sections.	10^{-6}–10^{-8}	Fair. Sheepsfoot roller; rubber-tired.	85–115	Fair to poor bearing.	None
POINSETT													
A_{1p}	0–6	5–8	Black	Silt loam	100	A-7-6(13)	OL [22]	Not suitable	10^{-4}–10^{-6}	Fair to poor. Sheepsfoot roller.	80–100	Fair to poor bearing; may have excessive settlement.	None
B_1	6–9	3–5	Very dark grayish brown.	Loam	100	A-7-6(13)	OL [22]	Not suitable	10^{-4}–10^{-6}	Same	80–100	Same	None
B_2	9–26	15–20	Dark grayish brown.	Loam	99	A-6(10)	CL	Stable; impervious cores and blankets.	10^{-6}–10^{-8}	Fair to good. Sheepsfoot roller; rubber-tired.	95–120	Good to poor bearing.	None
C_{ca}	26–42	12–18	Grayish brown, olive brown, and white.	Loam	100	A-6(10)	CL	Same	10^{-6}–10^{-8}	Same	95–120	Same	None
C_1	42–48	----------	Grayish brown and white.	Loam	98	A-6(10)	CL	Same	10^{-6}–10^{-8}	Same	95–120	Same	None
C_2	48–52	----------	Grayish brown and very pale brown.	Sandy loam.	98	A-6(10)	CL	Same	10^{-6}–10^{-8}	Same	95–120	Same	None
C_3	52–60	----------	Grayish brown, light olive brown, and dark yellowish brown.	Loam	98	A-6(10)	CL	Same	10^{-6}–10^{-8}	Same	95–120	Same	None
SINAI SILTY													
A_{1p}	0–8	----------	Black	Silty clay loam.	100	A-7-6(13)	OL or OH [23]	Not suitable	10^{-5}–10^{-7}	Poor to very poor. Sheepsfoot roller.	70–100	Very poor bearing.	None
B_2	8–17	----------	Dark grayish brown.	Silty clay	100	A-7-6(18)	CH or MH	Fair to poor stability.	10^{-5}–10^{-7}	Poor. Sheepsfoot roller.	75–100	Poor bearing.	None
B_{3ca}	17–23	----------	Olive brown.	Silty clay loam.	100	A-7-6(16)	CL or CH	Fair stability with flat slopes; thin cores, blankets, and dike sections.	10^{-6}–10^{-8}	Fair. Sheepsfoot roller; rubber-tired equipment.	85–115	Fair to poor bearing.	None

properties of important soil types—Continued

Characteristics pertinent to roads and airfield								
Value as foundation not subject to frost action	Value as base under bituminous pavement	Potential frost action	Compressibility and expansion	Drainage characteristics	Recommended compaction equipment, in order of preference	Modified A.A.S.H.O. maximum unit dry weight	Field CBR	Subgrade modulus K
						Lb. per cu. ft.		*Lb. per cu. in.*
Poor	Not suitable	Medium to high	Medium to high	Same	Sheepsfoot roller; rubber-tired	95–120	5–10	75–150
SILT LOAM								
Poor	Not suitable	Medium to high	Medium to high	Poor	Rubber-tired; sheepsfoot roller	90–105	4–8	100–200
Poor	Not suitable	Medium to high	Medium to high	Poor	Rubber-tired; sheepsfoot roller	90–105	4–8	100–200
Fair to poor	Not suitable	Medium to high	Medium	Practically impervious.	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
CLAY LOAM								
Poor to very poor	Not suitable	Medium to high	High	Same	Sheepsfoot roller; rubber-tired	85–105	3–8	75–150
Poor to very poor	Not suitable	Medium to high	High	Same	Sheepsfoot roller; rubber-tired	85–105	4–7	75–150
Poor	Not suitable	Medium to high	Medium to high	Same	Sheepsfoot roller; rubber-tired	95–120	5–10	75–150

TABLE 7.—*Classification and engineering*

Horizon	Depths	Thickness range	Color (moist)	Classification: USDA[6] Textural class	Classification: USDA[6] Percent passing #10 sieve	Classification: A.A.S.H.O.	Classification: Unified	Characteristics pertinent to embankments and foundations: Value for embankments	Permeability	Compaction; Characteristics and recommended equipment	Standard A.A.S.H.O. maximum unit dry weight	Value for foundation material	Requirements for seepage control
	Inches	*Inches*							*Cm. per sec.*		*Lb. per cu. ft.*		
B_{3ca2}	23–29	----------	Same	Silty clay	100	A-7-6(16)	CL or CH	Same	10^{-6}–10^{-8}	Same	85–115	Same	None
C_{ca1}	29–35	----------	Dark grayish brown and olive brown, banded.	Silty clay loam.	100	A-7-6(19)	CH	Same	10^{-6}–10^{-8}	Fair to poor. Sheepsfoot roller.	75–105	Same	None
C_{ca2}	35–46	----------	Same	Silty clay loam.	100	A-7-6(19)	CH	Same	10^{-6}–10^{-8}	Same	75–105	Same	None
C_g	46–60	------	Olive gray; many fine faint mottles of brown and dark red.	Silty clay	100	A-7-6(19)	CH	Same	10^{-6}–10^{-8}	Same	75–105	Same	None
SOLOMON													
A_1	0–7	----------	Black	Clay	100	A-7-5(20)	OH [24]	Not suitable	10^{-6}–10^{-8}	Poor to very poor. Sheepsfoot roller.	65–100	Very poor bearing.	None
B_{2g1}	7–14	----------	Very dark gray.	Clay	100	A-7-6(20)	OH [25]	Not suitable	10^{-6}–10^{-8}	Same	65–100	Same	None
B_{2g2}	14–22	----------	Very dark grayish brown.	Clay	100	A-7-6(20)	OH [26]	Not suitable	10^{-6}–10^{-8}	Same	65–100	Same	None
C_{gca1}	22–36	----------	Olive gray and white.	Clay	99	A-7-6(19)	CH	Fair to poor stability with flat slopes, thin cores, blankets, and dike sections.	10^{-6}–10^{-8}	Fair to poor. Sheepsfoot roller.	75–105	Fair to poor bearing.	None
C_{gca2}	36–43	----------	Same	Loam	96	A-7-6(15)	CL or CH	Same	10^{-6}–10^{-8}	Fair. Sheepsfoot roller; rubber-tired.	85–115	Same	None
C_{gca2} D_g.	43–47	----------	Same	Sandy loam.	56	A-7-6(15)	CL or CH	Same	10^{-6}–10^{-8}	Same	85–115	Same	None
D_g.	47–60	----------	Olive gray	Sandy loam.	56	A-1-b(0)	SM	Fairly stable; not particularly suited to shells, but may be used for impervious cores or dikes.	10^{-3}–10^{-6}	Good with close control of moisture. Rubber-tired; sheepsfoot roller.	110–125	Good to poor bearing, depending on density.	Upstream blanket and toe drainage or wells.
VIENNA													
A_{1p}	0–8	----------	Black	Loam	100	A-7-6(10)	OL [27]	Not suitable	10^{-4}–10^{-6}	Fair to poor. Sheepsfoot roller.	80–100	Fair to poor bearing; may have excessive settlement.	None

properties of important soil types—Continued

Characteristics pertinent to roads and airfield								
Value as foundation not subject to frost action	Value as base under bituminous pavement	Potential frost action	Compressibility and expansion	Drainage characteristics	Recommended compaction equipment, in order of preference	Modified A.A.S.H.O. maximum unit dry weight	Field CBR	Subgrade modulus K
						Lb. per cu. ft.		*Lb. per cu. in.*
Poor	Not suitable	Medium to high	Medium to high	Same	Sheepsfoot roller; rubber-tired	95–120	5–10	75–150
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	90–110	3–5	50–100
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	90–110	3–5	50–100
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	90–110	3–5	50–100
CLAY								
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	80–105	3–5	50–100
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	80–105	3–5	50–100
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	80–105	3–5	50–100
Poor to very poor	Not suitable	Medium	High	Same	Sheepsfoot roller	90–110	3–5	50 100
Poor	Not suitable	Medium to high	Medium to high	Same	Sheepsfoot roller; rubber-tired	95–120	5–10	75–150
Poor	Not suitable	Medium to high	Medium to high	Same	Sheepsfoot roller; rubber-tired	95–120	5–10	75–150
Good	Poor	Slight to high	Very slight	Fair to poor	Rubber-tired; sheepsfoot roller. Needs close control of moisture.	120–135	20–40	200–300
LOAM								
Poor	Not suitable	Medium to high	Medium to high	Poor	Rubber-tired; sheepsfoot roller	90–105	4–8	100–200

TABLE 7. — *Classification and engineering*

Horizon	Depths	Thickness range	Color (moist)	Classification: USDA (6) Textural class	Classification: USDA (6) Percent passing #10 sieve	Classification: A.A.S.H.O.	Classification: Unified	Characteristics pertinent to embankments and foundations: Value for embankments	Permeability	Compaction; Characteristics and recommended equipment	Standard A.A.S.H.O. maximum unit dry weight	Value for foundation material	Requirements for seepage control
									Cm. per sec.		*Lb. per cu. ft.*		
B_{21}	8-13	----------	Black and dark grayish brown.	Loam	97	A-7-6(10)	OL [13]	Not suitable.	10^{-4}–10^{-6}	Same	80-100	Same	None
B_{22}	13-18	----------	Dark grayish brown.	Loam	97	A-6(10)	CL	Stable; impervious cores and blankets.	10^{-6}–10^{-8}	Fair to good. Sheepsfoot roller; rubber-tired.	95-120	Good to poor bearing.	None
C_{ca}	18-40	----------	Grayish brown.	Clay loam.	95	A-6(10)	CL	Same	10^{-6}–10^{-8}	Same	95-120	Same	None
C	40-60	----------	Grayish brown, white, and yellowish brown.	Loam	97	A-6(10)	CL	Same	10^{-6}–10^{-8}	Same	95-120	Same	None

[1] Contains 9.1 percent organic matter and is 1 percent above A line (*9*).
[2] Contains 6.2 percent organic matter and is 4 percent above A line.
[3] Contains 2.4 percent organic matter and is 6 percent above A line.
[4] Contains 3.2 percent organic matter and is 2 percent above A line.
[5] Within 50± 3 percent passes No. 200 sieve.
[6] Contains 2.4 percent organic matter.
[7] Contains 5.7 percent organic matter and is 2 percent above A line.
[8] Contains 3.7 percent organic matter and is 4 percent above A line.
[9] Cobble lag materials with many lime segregations.
[10] Contains more than 2 percent organic matter and is 4 percent or less above A line.
[11] Contains 20.5 percent organic matter.
[12] Contains 16.7 percent organic matter.
[13] Contains 10.0 percent organic matter and is 4 percent above A line.
[14] Contains 3.2 percent organic matter and is 9 percent above A line.

mately the same way as the A.A.H.S.O. classification. Some procedures, however, should be explained. Borderline classification has been indicated. A soil material of which 50± 2 percent passes the No. 200 sieve has a classification such as SC or CL. A soil material with a liquid limit of 50± 2 percent has a classification such as CL or CH. A soil material that plotted on the plasticity chart within 2 percent of the A line (*9*) and was not organic has a classification such as MH or CH. For a soil material having 2+ percent organic matter the classification is OL, OH, or OL or OH, regardless of whether or not it plotted below the A line. Soil materials plotting in the hatched zone (*9*) were classified as CL-ML. None of the soils of table 7 have the classification CL-ML.

Soils not tested for engineering properties

Some soils that were not sampled for engineering tests can be compared with soils that were sampled and tested. The following is an estimate of the classification of some soils not listed in table 7.

Ahnberg loam is roughly comparable to Sinai silty clay, but the Sinai soil has a silt content about 20 percent higher and a clay content of about 10 percent higher than the Ahnberg loam. The Unified classification of Ahnberg loam below a depth of 6 inches would probably be CL.

Athelwold silty clay loam is comparable to Estelline silt loam, but it is moderately well drained instead of well drained. The Unified classification for Athelwold silty clay loam would probably be the same as for Estelline silt loam.

Brookings silty clay loam is a moderately well drained associate of Kranzburg silt loam. The Unified classification of Brookings silty clay loam below a depth of 17 inches would probably be CL.

Brookings silty clay loam, drainageways, is similar to Brookings silty clay loam, but it is located in upland drainageways and is wetter than Brookings silty clay loam.

Buse loam is comparable to Poinsett silt loam, but the Buse is over till and is thinner. The Unified classification of Buse loam below the surface soil would probably be CL.

Flandreau loam, deep over till, is comparable to Vienna loam, but the Flandreau soil has loam over sand, and the sand occurs at depths of about 3 to 5 feet and may be several feet thick. The underlying till is similar for Flandreau and Vienna soils. Flandreau loam, deep over till, has a silt content 15 to 20 percent higher than that of Vienna loam. Below 15 inches and continuing down to sand, the Unified classification of the Flandreau soil would probably be CL or CH.

Lismore silty clay loam is a moderately well drained associate of Vienna loam, but its silt content is 10 percent higher than that of Vienna loam. Below a depth of 16 inches, the Unified classification of Lismore silty clay loam would probably be CL or CH.

Moody silt loam is similar to Kranzburg silt loam

properties of important soil types—Continued

Characteristics pertinent to roads and airfield								
Value as foundation not subject to frost action	Value as base under bituminous pavement	Potential frost action	Compressibility and expansion	Drainage characteristics	Recommended compaction equipment, in order of preference	Modified A.A.S.H.O. maximum unit dry weight	Field CBR	Subgrade modulus K
Poor	Not suitable	Medium to high	Medium to high	Poor	Rubber-tired; sheepsfoot roller	90–105	4–8	100–200
Fair to poor	Not suitable	Medium to high	Medium	Practically impervious.	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200
Fair to poor	Not suitable	Medium to high	Medium	Same	Rubber-tired; sheepsfoot roller	100–125	5–15	100–200

[15] Contains 2.2 percent organic matter.
[16] Contains 5.1 percent organic matter and is 2 percent above A line.
[17] Contains 3.6 percent organic matter and is 2 percent above A line.
[18] Contains 3.1 percent organic matter and is 4 percent above A line.
[29] Contains 11.5 percent organic matter and is 5 percent above A line.
[10] Contains 9.3 percent organic matter and is 7 percent above A line.
[21] Contains 5.2 percent organic matter and is 10 percent above A line.
[22] Contains 3.0 to 5.4 percent organic matter and is 2 percent or less above A line.
[23] Contains 3.4 percent organic matter and is 2 percent or less below A line.
[24] Contains 6.8 to 7.5 percent organic matter and is 4 percent above A line.
[25] Contains 3.1 percent organic matter and is 7 percent above A line.
[26] Contains 2.0 percent organic matter and is 10 percent above A line.
[27] Contains 7.2 percent organic matter and is 4 percent above A line.
[28] Contains 2.0 percent organic matter and is 8 percent above A line.

except that the thickness of the loess over till is between 36 and 60 inches, and the arrangement of horizons in the profile differs.

Renshaw sandy loam is similar to Fordville loam, but it is thinner and has no C or C_a horizon. Outwash gravel occurs at depths of 10 to 20 inches in Renshaw sandy loam.

Sinai silty clay is comparable to Sinai silty clay loam. The Sinai silty clay has a clay content about 5 percent higher than that of Sinai silty clay loam. The Unified classification of the soil material in both profiles would probably be the same.

Engineering Data for Management Subgroups

In table 8, data are given for management subgroups on available moisture capacity, depth to seasonally high water table, and susceptibility to formation of traffic pans. These data are based on comparison with like soils of other counties, on inspection of profiles in Brookings County, on natural soil drainage, and on texture.

Glossary of Engineering Terms

A.A.S.H.O. American Association of State Highway Officials.

Base. Specified or selected material of planned thickness placed as foundation for a pavement.

Blanket. When this term is used in connection with foundation soil materials under embankments, it refers to a relatively thin extensive layer of soil that is placed on the upstream floor from an embankment for the purpose of retarding seepage through the foundation material.

C.B.R. California Bearing Ratio; the results of a strength test used for soil materials.

Core. When this term is used in connection with embankments, it usually refers to a vertical layer of a soil material that is placed inside the embankment for the purpose of decreasing seepage.

Lift. When used in connection with compacting soil materials, lift refers to layers of material placed and then compacted before adding another layer.

Modified A.A.S.H.O. compactive effort. The amount of compactive work used to compact a test sample of a soil material, according to the modified A.A.S.H.O. procedure for determining optimum moisture and maximum dry density of soil materials.

Optimum moisture content. The moisture content at which a soil material yields the highest dry density in the standard or modified test for optimum moisture and maximum dry density.

Pass. When referring to compaction of soil materials, pass means one trip over the soil with the compaction equipment.

Rubber-tired, or rubber-tired equipment. When used in connection with compaction, these terms refer to multiple-wheeled, rubber-tired compaction equipment.

Sheepsfoot roller. A type of roller used for compacting soil materials. It consists of a steel drum with projecting steel feet. The weight of the roller and the area of each foot may be varied to conform with the requirement of the soil material being compacted.

Shell. In connection with embankments, shell refers to a pervious relatively thin layer of material that is placed on the outside of the embankment for the purpose of protecting material underneath.

Standard A.A.S.H.O. compactive effort. The amount of compactive work used to compact a test sample of soil material according to the standard A.A.S.H.O. procedure for

TABLE 8.—*Data for soil management groups—available moisture capacity, depth to seasonally high water table, and susceptibility to formation of traffic pans*[1]

[See subsection, Soil Management Groups and Subgroups, for composition of soil management subgroups]

Soil management subgroup	Available moisture capacity [2]	Depth to a seasonally high water table	Susceptibility to formation of traffic pan [3]
		Feet	
1A	Moderate to high	Not within 5	Moderate to high.
1B	Moderate to high	3 to 5	Moderate to high.
2A	Moderate	Not within 5	Low to moderate
2B	Moderate	Not within 5	Low to moderate.
2C	Moderate	Not within 5	Low to moderate.
2D	High	Not within 5	Moderate to high.
3A	Moderate	Not within 5	Low to moderate.
3B	Moderate	Not within 5	Low to moderate.
3C	High	Not within 5	Moderate to high.
4A	(4)	Not within 5	Low.
4B	(4)	Not within 5	Low.
5A	Moderate	Not within 5	Low to moderate.
5B	Moderate	Not within 5	Low.
5C	(4)	Not within 5	Low.
5D	(4)	Not within 5	Low.
6A	Moderate [5]	Not within 5	Low.
6B	Moderate [5]	Not within 5	Low.
6C	Moderate [5]	Not within 5	Low.
6D	Moderate [5]	Not within 5	Very low.
6E	Low	Not within 5	Very low.
7A	Low	Not within 5	Very low.
7B	Low	Not within 5	Very low.
7C	Low	Not within 5	Very low.
8A	Moderate to high [5]	2	High.
8B	Moderate to high [5]	2 to 4	High.
8C	Moderate to high [5]	Surface	High.
8D	Moderate to high [5]	Surface	High.

[1] Data prepared by F. C. WESTIN, agronomist, South Dakota State College.
[2] The range in available moisture capacity for each class used in this table is as follows: Low, less than 1 in. per ft.; moderate, 1 in. to 2¾ in. per foot; high, 2¾ in. to 3 in. per ft.
[3] A traffic pan is soil compacted by machinery. For this table susceptibility was estimated by using natural soil drainage and soil texture as the principal criteria. All ratings are for soils in place.
[4] Not applicable because of excessive slope or thin soil, or both.
[5] Capacity given for soil down to gravel. See profile descriptions for depth to gravel.

determining optimum moisture and maximum dry density of soil materials (*1*).

Subbase. Specified or selected material of planned thickness placed as foundation for a base.

Subgrade material. The material in excavations (cuts), embankments (fills), and embankment foundations immediately below the first layer of subbase, base, or pavement, and to such depth as may affect the structural design.

Subgrade modulus. Results of a plate-bearing test for strength of soil materials.

Toe drainage. Usually consists of drainage trenches or relief wells used at the downstream toe of a dam for the purpose of protection against piping or boiling conditions where seepage water emerges from foundation material.

Wells. When this term is used in connection with seepage through foundations for embankments, it refers to relief wells used to accomplish toe drainage.

Agriculture of Brookings County[10]

Some characteristics of the agriculture of Brookings County are described briefly in this section, principally for readers not familiar with the county.

In 1950 the 1,924 farms of Brookings County averaged 255.1 acres in size and occupied 490,751 acres of the 512,640 acres in the county. Of the land in farms in 1949, 78.7 percent was in cropland, 17.8 percent in pasture, and 3.5 percent in miscellaneous uses.

Crops

The crop summary of Brookings County for 1955 and the averages for 10 years, 1941 through 1950, are given in table 9.

Livestock

Production of livestock and livestock products is the main enterprise of most of the farms of Brookings

TABLE 9.—*Crop summary: Acreage harvested, yield per acre, and production for 1955 and averages for 10 years, 1941-1950*[1]

Crop	Acreage harvested		Yield per acre		Production	
	1955	Average (1941-1950)	1955	Average (1941-1950)	1955	Average (1941-1950)
			Bu.	*Bu.*	*Bu.*	*Bu.*
Corn, all	122,800	127,860	30.0	31.7	3,684,000	4,077,610
Wheat	980	[2] 12,286	15.1	14.8	14,800	[2] 181,206
Winter	90	182	21.0	10.3	1,890	2,337
Durum	90	785	19.0	14.2	1,710	10,719
Other spring	800	11,319	14.0	14.8	11,200	168,150
Oats	117,800	119,130	34.0	36.3	4,005,200	4,337,760
Barley	6,400	20,900	26.0	25.7	166,400	522,940
Rye	1,600	4,950	14.5	12.3	23,200	64,060
Flaxseed	35,500	23,040	10.5	10.5	372,800	242,490
Sorghums, for all purposes	[3] 260	4,601				
Alfalfa seed	900	489				
Sweetclover seed	2,900	776				
			Tons	*Tons*	*Tons*	*Tons*
Alfalfa hay	36,500	13,390	1.25	1.75	45,600	23,378
Wild hay	13,200	17,180	.90	1.00	11,900	17,080

[1] The data in this table are from estimates made annually for all counties and published in the annual reports of the South Dakota Crop and Livestock Reporting Service, a cooperative service of the United States Department of Agriculture and the South Dakota Department of Agriculture (*7*).
[2] Average for winter, Durum, and other spring wheats.
[3] Acres planted.

[10] This section written by F. C. WESTIN, agronomist, South Dakota State College.

County. The inventory numbers of livestock on farms for stated years are shown in table 10.

TABLE 10. — *Livestock on farms: January 1 inventory for stated years*

Year	All cattle	Cows and heifers 2 or more years old		Hogs	Sheep and lambs	Horses and mules
		Mainly for milk	Mainly for beef [1]			
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
1940	43,700	16,900	1,600	67,000	48,000	8,200
1945	57,600	17,000	6,400	61,000	42,200	5,900
1950	46,400	13,700	5,800	57,800	22,200	2,900
1955	63,600	11,900	----------	52,500	31,200	900
1956	63,600	12,100	----------	55,100	32,000	----------

Data from Brookings County Agriculture. South Dakota Crop and Livestock Reporting Service, Sioux Fall, S. Dak.

Farm Tenacy

The U. S. Bureau of Census classification of Brookings County farms by tenure of operator is shown in table 11. In 1945, tenancy was about 43 percent; in 1950, it was about 36 percent.

TABLE 11. — *Farms by tenure of operator*

Tenure	1945	1950
	Number	*Number*
All farms	1,880	1,924
Full owners	641	790
Part owners	420	433
Managers	14	2
All tenants	805	699
Cash tenants	40	66
Share-cash tenants	77	421
Share tenants and croppers	567	155
Other and unspecified tenants	121	57

History, Population, and Transportation[11]

Before the middle of the last century Brookings County was inhabited by tribes of Sioux Indians. Large numbers of buffalo, elk, beaver, and smaller animals lived in the county. By the middle of the 1860's most of the Indians had moved out of this area, perhaps because of the westward shift of the buffalo herds. In 1851 the part of Brookings County lying east of the Big Sioux River was bought from the Sioux Indians. The part lying west of the river was bought in 1858.

The first white man of record to visit the county was Philander Prescott, a fur trader, who briefly visited the Medary region in the spring of 1833. In July 1838 two noted explorers, Joseph N. Nicollet and John Charles Fremont, crossed the county from near Elkton to Lake Poinsett. They named Lake Albert and Lake Poinsett, which border the county on the northwest.

In the summer of 1857 the Pacific Wagon Road, known also as Nobles Trail, was built across the southern tier of townships, but it was used little. At the same time a settlement was made at Medary, about 7 miles south of Brookings, but a large party of Indians drove the settlers away. The Panic of 1857, hard times, and the Sioux Uprising of 1862 discouraged further attempts at settlement until 1869.

Norwegians arrived in 1869 as the first permanent settlers of Brookings County. During the next few years other Norwegians and people of old American ancestry came in. But grasshopper plagues in the middle 1870's caused some settlers to leave and discouraged further settlement. It is estimated that in the spring of 1877 less than 250 persons lived in Brookings County, but during the next few years population increased, and in 1880 was 4,965. About one-third of this number was of Norwegian ancestry. The number of people in the county in 1890 was slightly more than twice the 1880 figure. From the 1910's into the 1940's the population was more than 16,000. Seven of the eight towns were settled between 1879 and 1884, when the railroads were built through the county. Sinai was settled in 1907. At this time a railroad was constructed across the southwestern corner of the county. In 1900 a railroad was built across the northeastern tip of the county.

Brookings County was established April 15, 1862, but it was not organized until July 3, 1871. The present boundaries were established in 1873. Before this time, the western boundary was one tier of townships farther west, and the southern boundary was two tiers of townships farther south into the center of what is now Moody County.

Brookings was made the county seat in 1879, and since 1880 it has always been the leading town of the county. During the last decade, half of the people of the county lived in Brookings. The 1950 U. S. Census gives the following population for the towns of the county: Aurora, 202; Brookings, 7,764; Bruce, 305; Bushnell, 96; Elkton, 657; Sinai, 181; Volga, 578; and White, 525. The county had a population of 17,851 persons in 1950.

South Dakota State College was established at the town of Brookings in 1881, and the college opened in 1884. By 1902 the enrollment had reached 609. In 1940–41 it was 1,501; in 1955–56 it was more than 2,700.

United States Highways Nos. 14 and 77 pass through the central part of the county. Shopping centers can be reached easily from all parts of the county by State and county roads.

[11] This section written by D. D. PARKER, History Department, South Dakota State College.

Glossary of Agricultural Terms

Alluvium. Sand, mud, or other fine sediments deposited on land by streams.

Calcareous soil. Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibily to the naked eye when treated with hydrochloric acid. Soil

alkaline in reaction because it contains free calcium carbonate.

Catena. A group of associated soils, developed from the same kind of parent material, that differ from each other in drainage and relief.

Clay. Mineral soil grains less than 0.002 mm. (0.000079 inch) in diameter.

Claypan. A dense and heavy soil horizon underlying the upper part of the soil. Claypan is hard when dry and plastic or sticky when wet.

Colluvium. Deposits of soil material accumulated at the base of slopes through the combined influences of water and gravity.

Complex. A soil association mapped as a unit because it is composed of two or more soils that occur together in such an intricate pattern or in individual areas so small that they cannot be shown separately on maps of the scale used.

Consistence (soil). The degree of firmness of soil aggregates, or of entire soil horizons, due to the attraction of particles for one another and expressed in terms of resistance of soil to crushing, as loose, compact, friable, crumbly, plastic, soft, firm, hard, and cemented.

Cropland. Land regularly used for crops, except forest crops. Cropland includes rotation pasture, cultivated summer fallow, or other land ordinarily used for crops but temporarily idle.

Fertility. The quality that enables a soil to provide the proper compounds, in proper quantities and balance, for the growth of specified plants when light, temperature, moisture, physical condition of the soil, and other factors are favorable.

Friable. Easily crumbled in the fingers; nonplastic.

Genesis (soil). Mode of origin of the soil. Soil genesis refers particularly to the processes causing the development of the solum from unconsolidated parent materials.

Glacial drift. Rock and earth materials that have been transported and deposited by glacial action. Physically, drift may be divided into four groups: Till, outwash, lacustrine deposits, and ice-contact-stratified drift.

Glacial till. Unsorted clay, silt, sand, and boulders transported and deposited by ice.

Granular. A term of structure used for soil that consists of roughly spherical aggregates, which are either hard or soft.

Green-manure crop. Any crop grown and plowed under for the purpose of improving soil, especially by adding organic matter.

Horizon. A layer of soil approximately parallel to the land surface, with relatively well defined characteristics that have been produced through soil-building processes.

Humus. The well-decomposed or more or less stable part of the organic matter of the soil.

Ice-contact-stratified drift. Rock and earth materials of glacial origin having a unique surface form and a disturbed internal structure caused by having accumulated upon or against melting glacial ice. This drift commonly occurs as mounds or knolls pitted with close depressions of various diameters.

Lacustrine deposits. Materials deposited by lake waters.

Leaching. Removal of materials in solution.

Loam soil. Soil having approximately equal amounts of sand, silt, and clay.

Loess. A fine textured, usually silty, deposit laid down by wind.

Massive. A term of structure used to describe soils with large, uniform, cohesive masses and sometimes for those with ill-defined and irregular breakage.

Nutrients, plant. The elements essential to plant growth that may be taken in by plants. They include nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from air and water.

Outwash. Crossbedded gravel, sand, and silt which were deposited by melt water as it flowed from the ice.

Parent material. The unconsolidated mass from which the soil profile developed.

Permeability. That quality of a soil that allows it to transmit water or air.

pH. A term used to indicate the acidity and alkalinity of soils. A pH of 7.0 indicates precise neutrality; large numbers (up to 14.0), alkalinity; and smaller ones (down to 0.0) acidity.

Phase. A subdivision of a soil type that is usually made on the basis of difference in such characteristics as relief, accelerated erosion, or stoniness. Phase variations have practical importance, although they may or may not be reflected in the profile.

Platy. A term of structure used for soils with thin, horizontal plates, usually not well-defined.

Prismatic. A prismlike soil structure; the vertical axis longer than the horizontal; vertical faces well defined; without rounded tops. An example is in the B horizon of Poinsett loam.

Productivity. The capability of a soil to produce a specified plant or sequence of plants under a specified system of management.

Profile soil. A vertical section of the soil through all its horizons and extending into the parent material.

Sand. Rock or mineral fragments with diameters ranging between 0.05 mm. (0.002 inches) and 1.0 mm. (0.039 inches). The term sand is also applied to soils containing 90 percent or more of sand.

Series. A group of soils having genetic horizons similar as to differentiating characteristics and arrangement in the soil profile, except for the texture of the surface soil, and developed from a particular type of parent material. A series may include two or more soil types, and these types differ from one another in the texture of the surface soil.

Silt. Small mineral soil grains ranging from 0.05 mm. (0.002 inch) to 0.002 mm. (0.000079 inch) in diameter.

Soil. A natural body on the surface of the earth in which plants grow. Soil is composed of organic and mineral materials.

Soil textural class. A classification based on the relative proportion of soil separates. The principal classes in the county, in increasing order of the content of the finer separates, are as follows: Sand, loamy sand, sandy loam, loam, silt loam, silty clay loam, clay loam, and clay.

Soil separates. The individual size groups of soil particles, as sand, silt, and clay.

Solum. The upper part of the profile above the parent material. In mature soils this includes the A and B horizons (surface soil and subsoil).

Structure. The aggregates in which the individual soils particles are arranged. The principal types of structure in the soils of this county are granular, massive, platy, single grain, blocky, and prismatic.

Subsoil. That part of the soil profile commonly below plow depth and above the parent material

Texture. The relative proportion of the various size groups of individual soil grains.

Tilth. The physical condition of a soil in respect to its fitness for the growth of a specified plant.

Topography. The elevations or inequalities of the land surface. In soil descriptions the more specific terms—relief, physiography, land form, or slope—should be used.

Type. Soils having similar genetic horizons and characteristics, including texture and arrangement in the soil profile, and developed from a particular kind of parent material are classified as a soil type.

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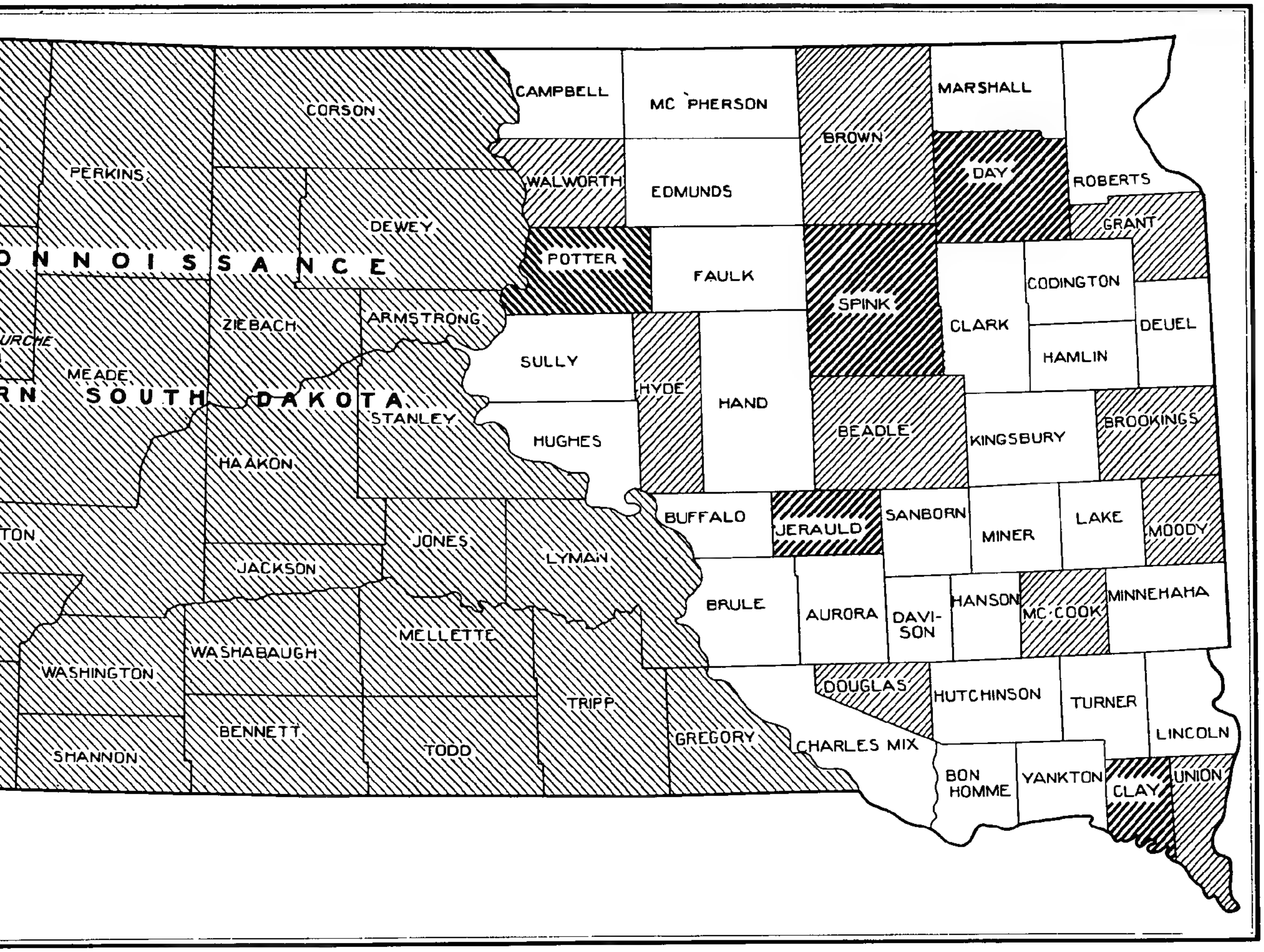
☆ U. S. GOVERNMENT PRINTING OFFICE: 1956—431615



l in South Dakota shown by shading. Detailed surveys shown by northeast-southwest hatching; reconnaissance sur-
northwest-southeast hatching; crosshatching indicates areas covered by both detailed and reconnaissance surveys. Heavy
lines in hatching indicate soil surveys published by the South Dakota Agricultural Experiment Station.

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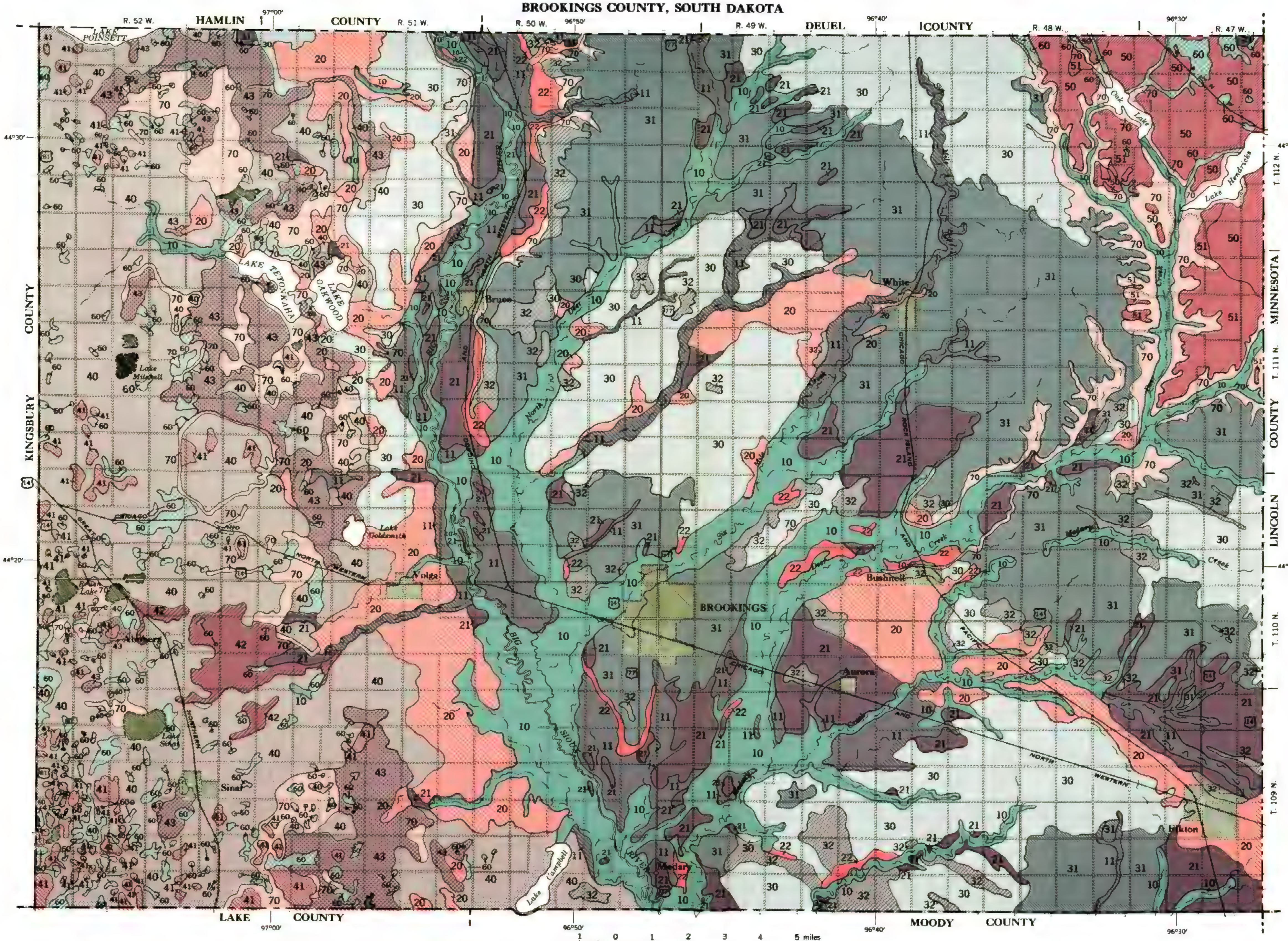
GENERAL SOIL AREAS

BROOKINGS COUNTY, SOUTH DAKOTA



(Each area consists chiefly of the soils listed; most areas contain other soils)

NEARLY LEVEL MEDIUM-TO FINE-TEXTURED SOILS OF BOTTOM LANDS

- 10 Deep soils from alluvium; Lamoure, Solomon, and Rauville
- 11 Soils in alluvium, moderately deep to gravel; Volga

NEARLY LEVEL MEDIUM-TEXTURED SOILS OF TERRACES

- 20 Loess-mantled soils, deep to gravel; Estelline, Athelwold
- 21 Alluvium-mantled soils, moderately deep or shallow to gravel; Fordville, Renshaw, and Sioux
- 22 Sandy soils of low terraces; Hecla

GENTLY SLOPING TO SLOPING MEDIUM-TEXTURED SOILS OF THE CENTRAL UPLAND

- 30 Soils in loess-mantled till; Kranzburg, Brookings, and Hidewood
- 31 Soils in till; Vienna, Lismore, and Leota series and small areas of Vienna-Buse and Vienna-Buse-Pierce complexes
- 32 Loams and sandy loams; Flandreau, Egeland, Maddock, and Dickey

GENTLY UNDULATING, UNDULATING, AND ROLLING SOILS OF THE WESTERN UPLAND

- 40 Undulating silty soils; Poinsett and Waubay
- 41 Gently undulating silty clay loams of the tops of flat-topped hills; Sinai
- 42 Undulating loams and silt loams; Ahnberg and Poinsett
- 43 Rolling areas, complexes of the Poinsett, Buse, and Pierce series

GENTLY UNDULATING, UNDULATING, AND ROLLING SOILS OF THE NORTHEAST UPLAND

- 50 Gently undulating loams and silt loams having worm-worked profiles; Singsaas and Oak Lake series
- 51 Undulating and rolling areas, complexes of the Singsaas, Buse, and Pierce series

SOILS OF DEPRESSIONS

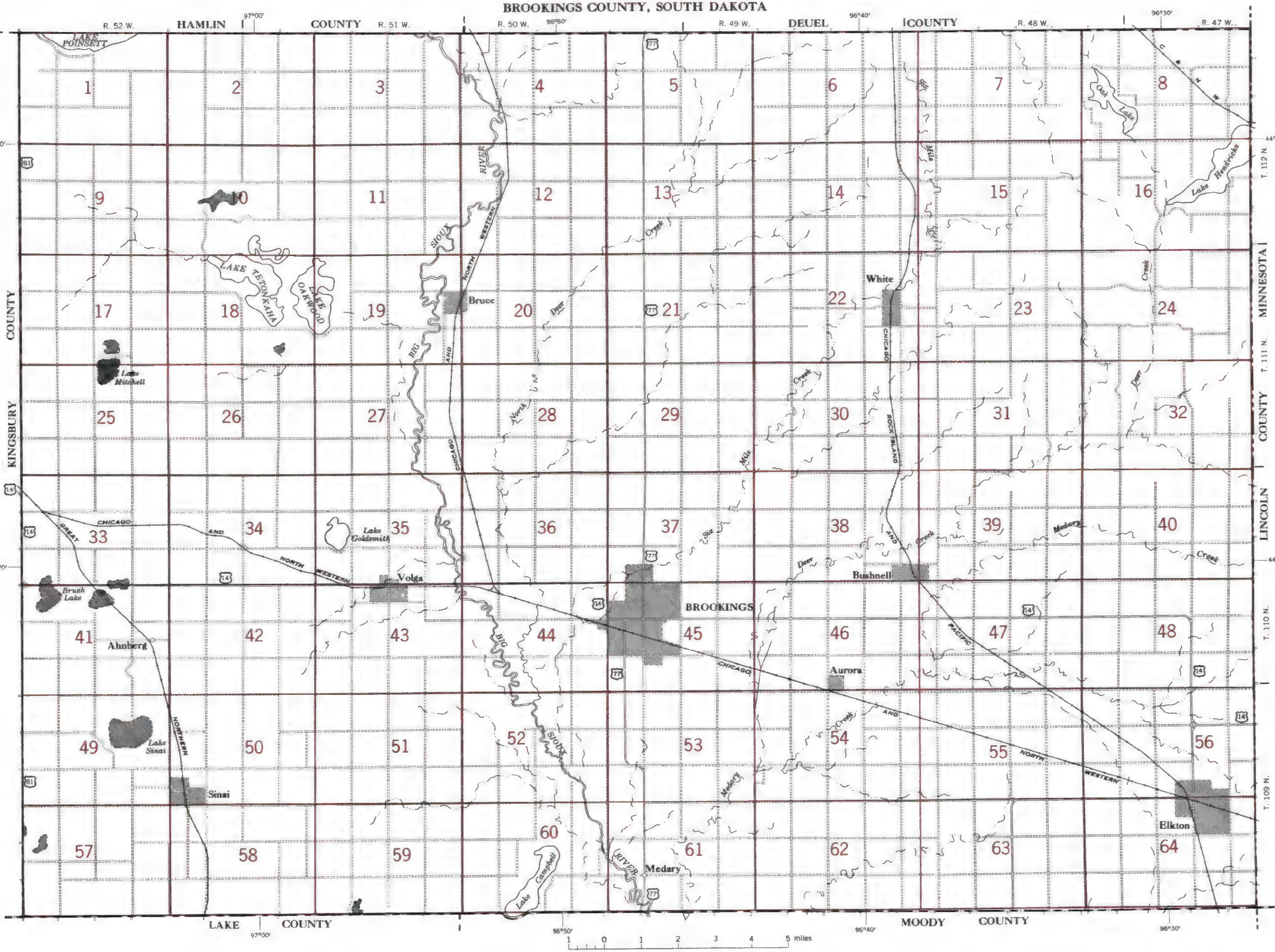
- 60 Marshland and low-lying depressional soils; Oldham, Tetonka, and Parnell

HILLY OR STEEP LAND

- 70 Hilly or steep land; Buse and Pierce

INDEX TO MAP SHEETS

BROOKINGS COUNTY, SOUTH DAKOTA



SOILS LEGEND

SYMBOL	NAME
Aa	Ahnberg-Poinsett complex, gently undulating
Ab	Ahnberg-Poinsett complex, undulating
Ac	Athelwold silty clay loam, nearly level
Ba	Brookings silty clay loam, nearly level
Bb	Brookings silty clay loam, drainageways
Bc	Buse complexes, undulating
Bd	Buse complexes, rolling
Be	Buse complexes, hilly
Bg	Buse stony complexes, undulating
Bh	Buse stony complexes, rolling
Da	Dickey sandy loam, gently undulating
Db	Dickey sandy loam, undulating
Ea	Egeland sandy loam, nearly level
Eb	Egeland sandy loam, gently undulating
Ec	Egeland sandy loam, deep over loamy drift, nearly level
Ed	Egeland sandy loam, deep over loamy drift, gently undulating
Ee	Estelline silt loam, nearly level
Eg	Estelline silt loam, gently sloping
Eh	Estelline silt loam, moderately shallow, nearly level
Ek	Estelline silt loam, moderately shallow, gently sloping
Fa	Flandreau loam, deep, nearly level
Fb	Flandreau loam, deep, gently undulating
Fc	Flandreau loam, deep over till, nearly level
Fd	Flandreau loam, deep over till, gently sloping
Fe	Flandreau loam, deep over till, sloping
Fg	Flandreau silt loam, nearly level
Fh	Flandreau silt loam, gently sloping
Fk	Flandreau silt loam, deep, nearly level
Fm	Fordville loam, nearly level
Fn	Fordville loam, gently undulating
Fo	Fordville loam, thick solum, nearly level
Fp	Fordville loam, deep, nearly level
Fr	Fordville sandy loam, nearly level
Fs	Fordville sandy loam, gently undulating
Ha	Hecla loam, undulating
Hb	Hecla sandy loam, nearly level
Hc	Hidewood silty clay loam, nearly level
Ka	Kranzburg loam, nearly level
Kb	Kranzburg loam, gently sloping
Kc	Kranzburg silt loam, nearly level
Kd	Kranzburg silt loam, gently sloping
Ke	Kranzburg silt loam, sloping
La	Lamoure silty clay loam, nearly level
Lb	Leota silty clay loam, nearly level
Lc	Lismore silty clay loam, nearly level
Ld	Lismore silty clay loam, drainageways
Ma	Maddock sandy loam, nearly level
Mb	Maddock sandy loam, undulating
Mc	Marsh
Md	Moody silt loam, nearly level
Me	Moody silt loam, gently sloping
Oa	Oak Lake silt loam, nearly level
Ob	Oak Lake silty clay loam, drainageways
Oc	Oldham silty clay loam, nearly level
Pa	Parnell silty clay loam, nearly level
Pb	Pierce complexes, hilly
Pc	Poinsett silt loam, nearly level
Pd	Poinsett silt loam, gently undulating
Pe	Poinsett silt loam, undulating
Pg	Poinsett-Buse-Pierce soils, gently undulating
Ph	Poinsett-Buse-Pierce soils, undulating
Pk	Poinsett-Buse-Pierce soils, rolling
Ra	Rauville silty clay loam, nearly level
Rb	Renshaw sandy loam, nearly level
Rc	Renshaw sandy loam, gently sloping
Sa	Sinai silty clay loam, nearly level
Sb	Sinai silty clay loam, gently sloping
Sc	Sinai silty clay loam, sloping
Sd	Singsaas loam, gently undulating
Se	Singsaas loam, undulating
Sg	Singsaas-Buse loams, gently undulating
Sh	Singsaas-Buse loams, undulating
Sk	Singsaas-Buse-Pierce loams, undulating
Sm	Singsaas-Buse-Pierce loams, rolling
Sn	Sioux gravelly loam, gently undulating
So	Solomon clay, nearly level
Ta	Terrace escarpments, sloping
Tb	Tetonka silty clay loam, nearly level
Va	Vienna loam, nearly level
Vb	Vienna loam, gently sloping
Vc	Vienna loam, sloping
Vd	Vienna sandy loam, gently undulating
Ve	Vienna sandy loam, undulating
Vg	Vienna-Buse loams, gently undulating
Vh	Vienna-Buse loams, undulating
Vk	Vienna-Buse loams, steep
Vm	Vienna-Buse-Pierce loams, undulating
Vn	Vienna-Buse-Pierce loams, rolling
Vo	Volga loam, somewhat poorly drained, nearly level
Vp	Volga silty clay loam, somewhat poorly drained, nearly level
Vr	Volga silty clay loam, poorly drained, nearly level
Wa	Waubay silty clay loam, nearly level
Wb	Waubay silty clay loam, drainageways

Soils surveyed 1949-55 by F. C. Westin, G. J. Buntley, F. E. Shubeck, W. M. Moldenhauer, J. M. Beardsley, A. J. Klingelhoets, G. B. Lee, J. U. Anderson, J. K. Krueger, and D. I. Kettering, South Dakota State Agricultural College. Correlation by C. A. Mogen, U. S. Department of Agriculture; F. C. Westin, and G. J. Buntley, South Dakota Agricultural Experiment Station.

Soil map constructed by Cartographic Division, Soil Conservation Service, USDA, from 1951 aerial photographs. Controlled mosaic based on polyconic projection, 1927 North American datum.

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

- Roads
  - Good motor
  - Poor motor
  - Trail
  - Marker, U. S.
- Railroads
  - Single track
  - Multiple track
  - Abandoned
- Bridges and crossings
  - Road
  - Trail, foot
  - Railroad
  - Ferry
  - Ford
  - Grade
  - R. R. over
  - R. R. under
  - Tunnel
- Buildings
  - School
  - Church
  - Station
- Mine and Quarry
  - Shaft
  - Dump
  - Prospect
- Pits, gravel or other — GP
- Power line
- Pipeline
- Cemetery
- Dam
- Levee
- Tank
- Oil well
- Windmill
- Canal lock (point upstream)

BOUNDARIES

- National or state
- County
- Township, civil
- U. S.
- Section
- City (corporate)
- Reservation
- Land grant

DRAINAGE

- Streams
  - Perennial
  - Intermittent, unclass.
  - Crossable with tillage implements
  - Not crossable with tillage implements
- Canals and ditches — CANAL, DITCH
- Lakes and ponds
  - Perennial
  - Intermittent
- Wells — flowing
- Springs
- Marsh
- Wet spot

RELIEF

- Escarpments
  - Bedrock
  - Other
- Prominent peaks
- Depressions (Large, Small)
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Contains water most of the time

SOIL SURVEY DATA

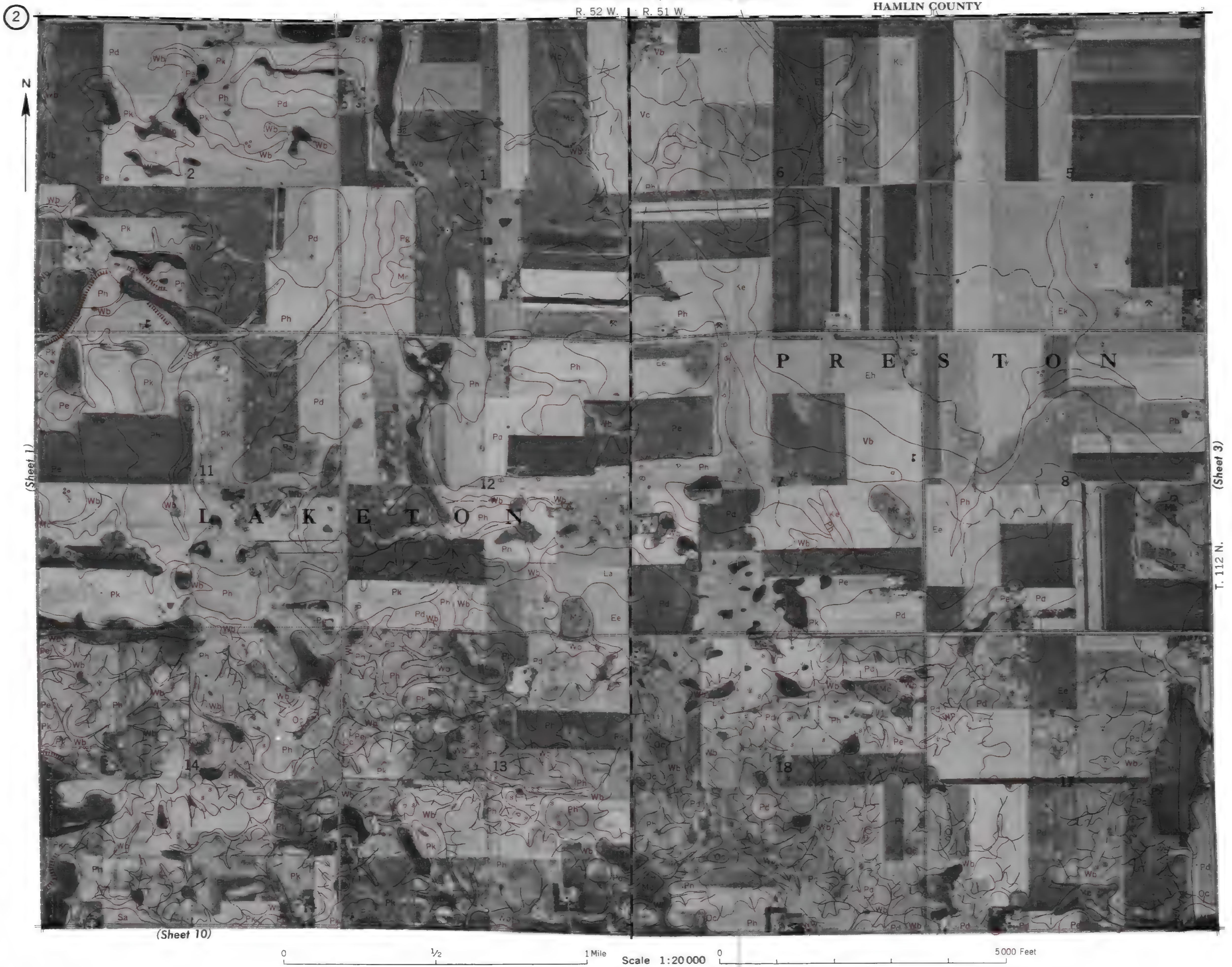
- Soil type outline and symbol — Dx
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Kitchen midden
- Erosion
  - Uneroded spot — U
  - Sheet, moderate — S
  - Sheet, severe — SS
  - Gully, moderate — G
  - Gully, severe — GG
  - Sheet and gully, moderate — SG
  - Wind, moderate
  - Wind, severe
  - Blowout
  - Wind hummock
  - Overblown soil
- Gullies
  - Crossable with tillage implements
  - Not crossable with tillage implements
- Areas of alkali and salts
  - Strong — A
  - Moderate — M
  - Slight — S
  - Free of toxic effect — F
  - Sample location — 26
  - Saline spot

BROOKINGS COUNTY, SOUTH DAKOTA

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

2



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0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

④

BROOKINGS COUNTY, SOUTH DAKOTA

HAMLIN COUNTY
DEUEL COUNTY

R. 50 W.

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

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R. 50 W.
R. 49 W.
DEUEL COUNTY
5
N
EUREKA
ARGO
(Sheet 4)
(Sheet 6)
(Sheet 13)
T. 112 N.
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

6

DEUEL COUNTY   R. 49 W. | R. 48 W.

(Sheet 5)

(Sheet 7)

(Sheet 14)

0   ½   1 Mile   Scale 1:20 000   0   5000 Feet

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R. 48 W.
DEUEL COUNTY
N
T. 112 N.
(Sheet 6)
(Sheet 8)
(Sheet 15)
O A K L A K E
0
1/2
1 Mile
Scale 1:20000
0
5000 Feet

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R. 52 W.
(Sheet 1)
N
KINGSBURY COUNTY
T. 112 N.
(Sheet 10)
(Sheet 17)
19
20
21
22
30
29
28
27
31
32
33
34
L A K E T O N
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

10

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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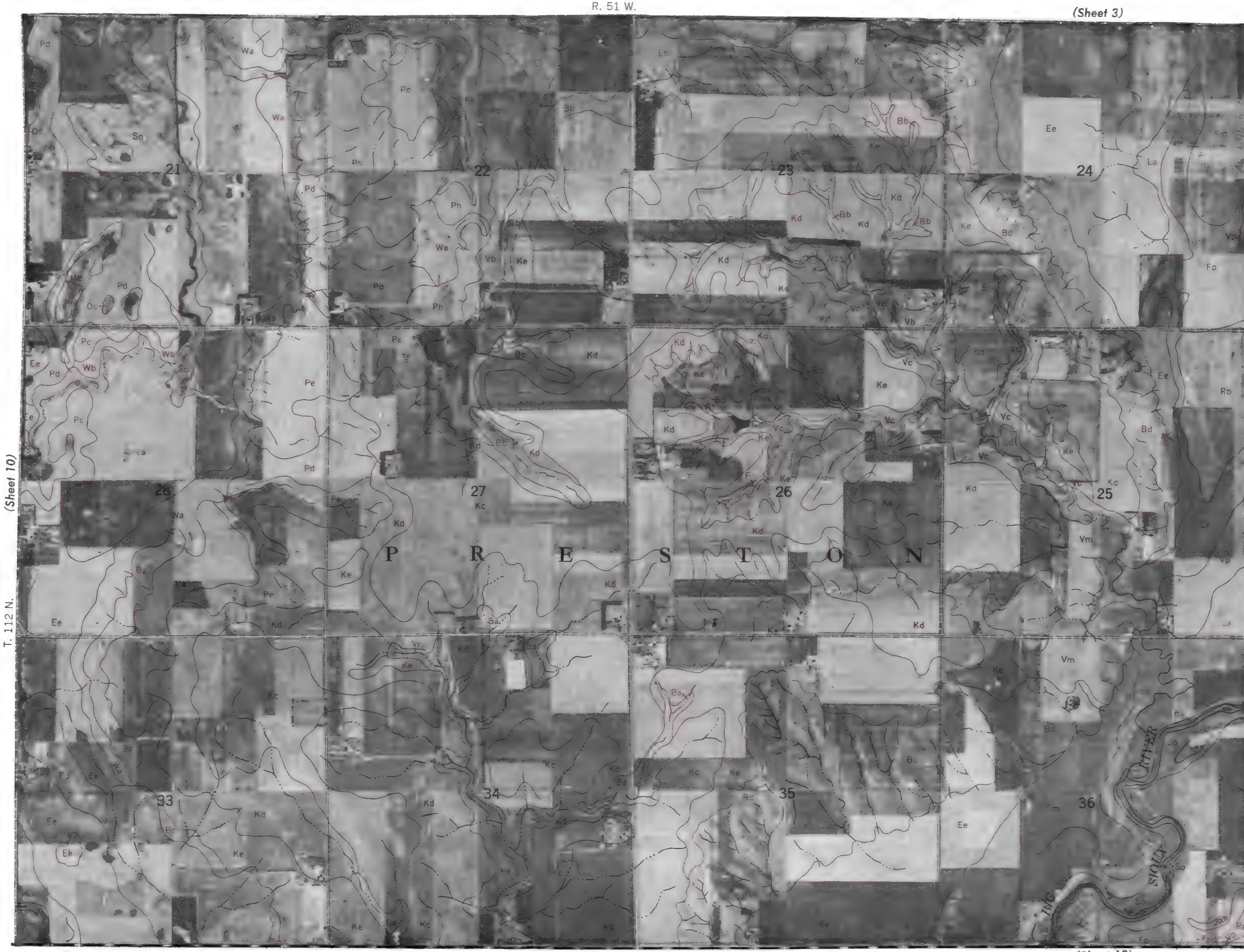
R. 51 W.

(Sheet 3)

N

(Sheet 10)

T. 112 N.



(Sheet 12)

(Sheet 19)

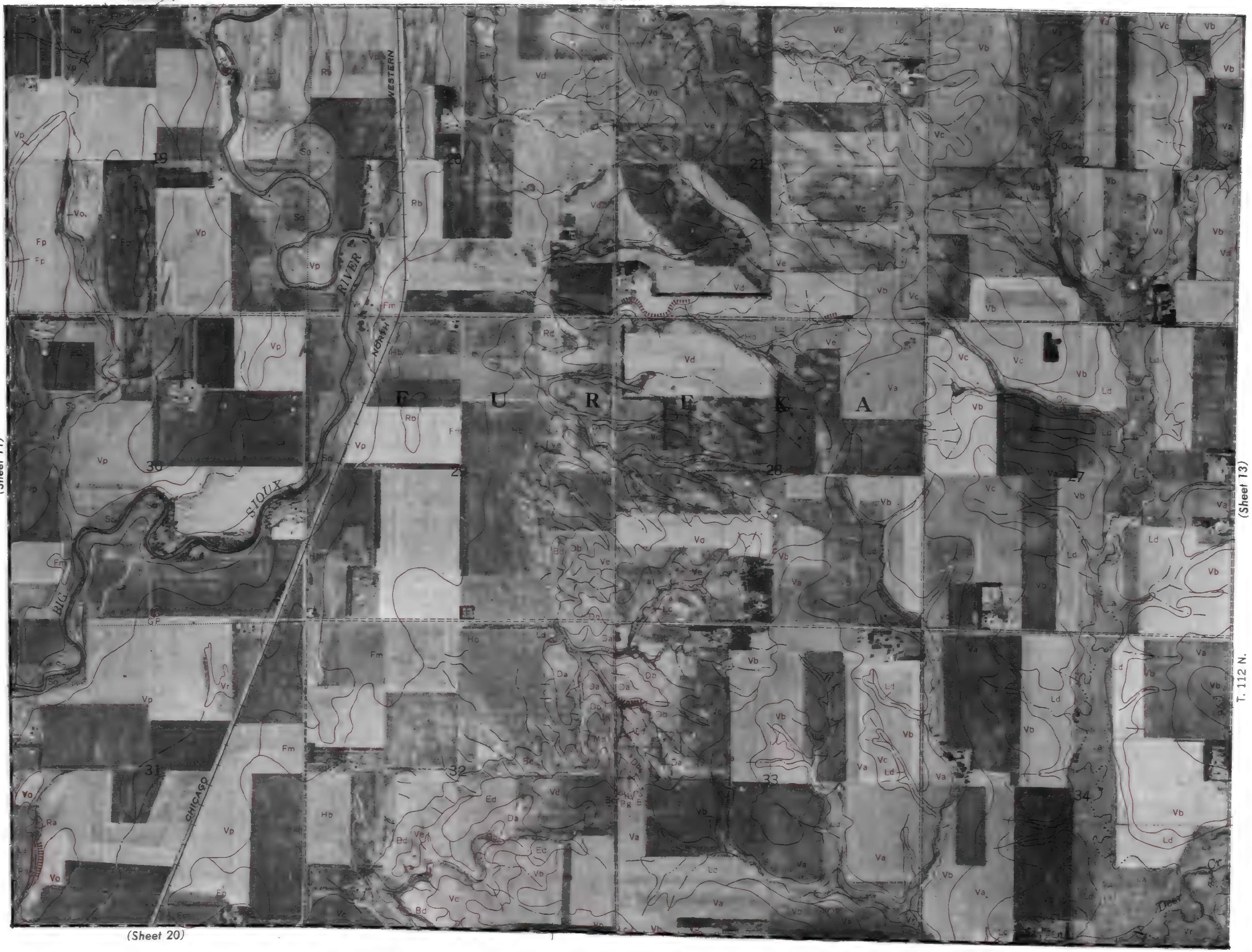
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

(Sheet 4)

R. 50 W.

(Sheet 11)



(Sheet 13)

T. 112 N.

(Sheet 20)

0 1/2 1 Mile Scale 1:20 000 0 5000 Feet

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BROOKINGS COUNTY, SOUTH DAKOTA

(Sheet 6)

(Sheet 13)

(Sheet 15)

T. 112 N.

(Sheet 22)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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R. 48 W.

(Sheet 7)

(Sheet 23)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(16)

(Sheet 8) R. 48 W. R. 47 W.

(Sheet 15)

MINNESOTA

T. 112 N.

LINCOLN COUNTY

(Sheet 24)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

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R. 51 W.

(Sheet 11)

(Sheet 18)

T. 111 N.

(Sheet 20)

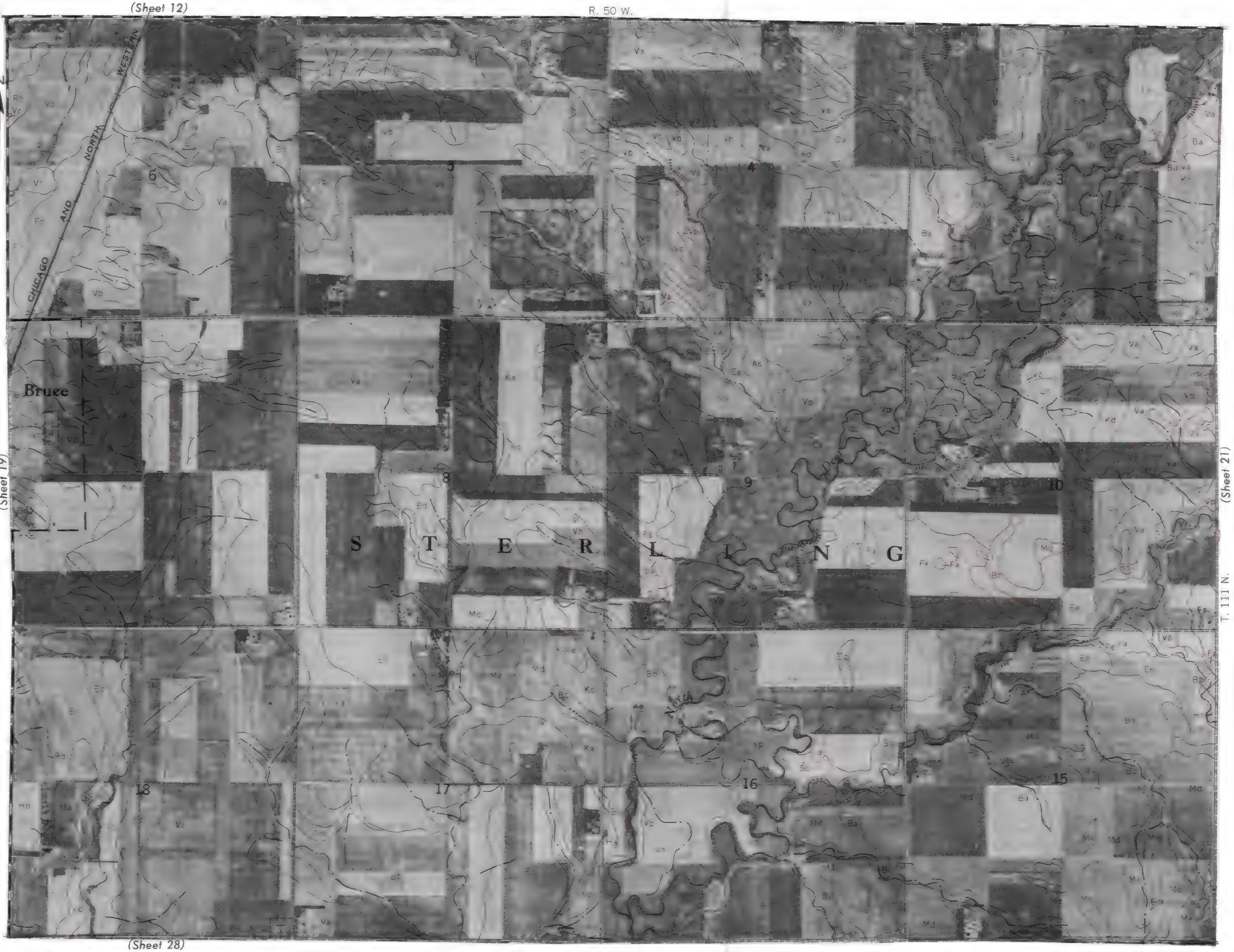
(Sheet 27)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

20

(Sheet 12)

R. 50 W.



(Sheet 19)

(Sheet 21)

T. 111 N.

(Sheet 28)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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R. 50 W.
R. 49 W.
(Sheet 13)
N
(Sheet 20)
(Sheet 22)
(Sheet 29)
T. 111 N.
S T E R L I N G
A F T O N
2
1
6
5
11
12
7
8
14
13
18
17
0
½
1 Mile
Scale 1:20 000
0
5 000 Feet

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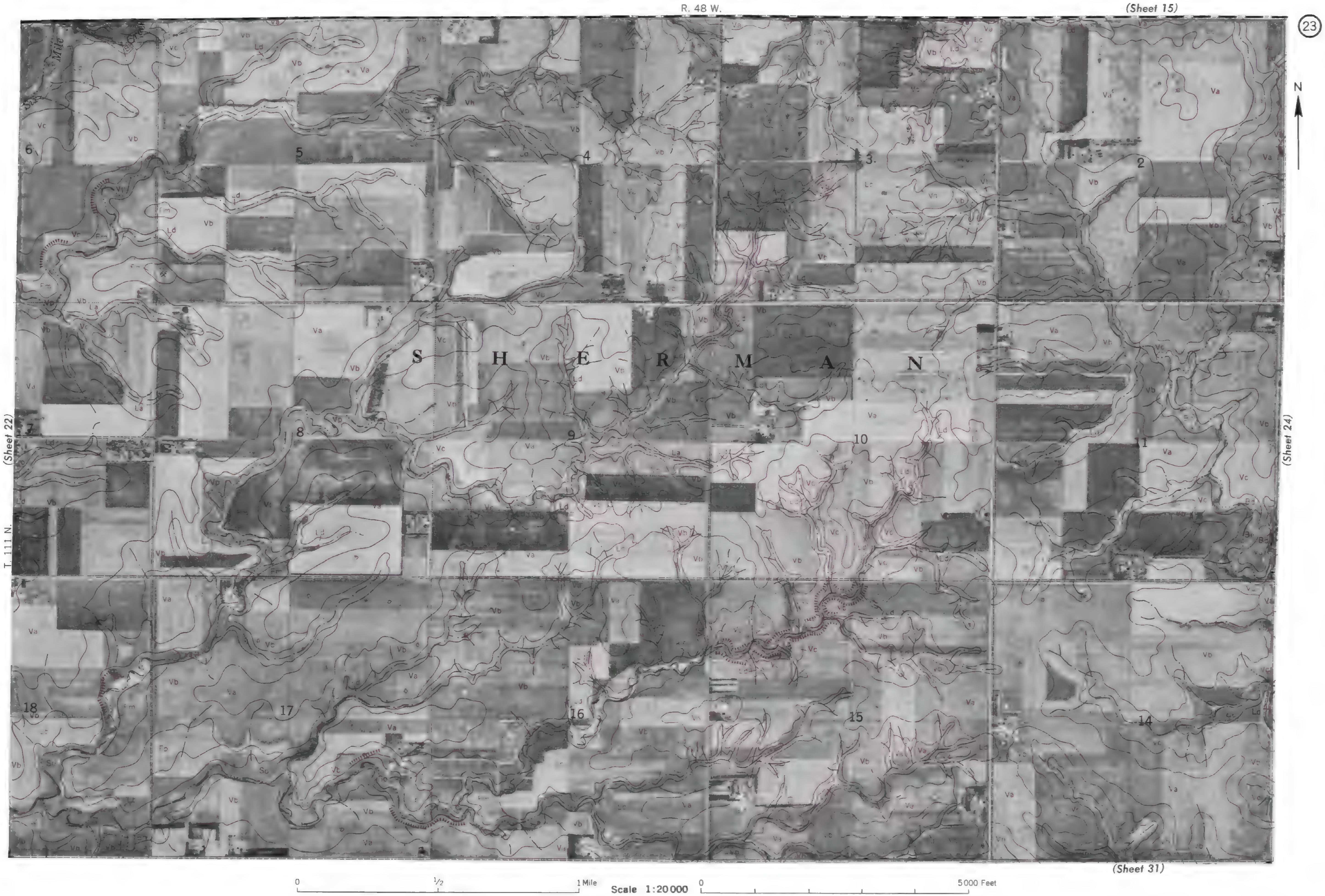
R. 48 W.
(Sheet 15)
23
N
S H E R M A N
(Sheet 22)
(Sheet 24)
T. 111 N.
(Sheet 31)
0 ½ 1 Mile
Scale 1:20 000
0 5000 Feet

(Sheet 16) R. 48 W. R. 47 W.

N

(Sheet 23)

MINNESOTA

T. 111 N.

LINCOLN COUNTY

(Sheet 32)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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R. 52 W.

(Sheet 17)

KINGSBURY COUNTY

T. 111 N.

(Sheet 26)

(Sheet 33)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

26

BROOKINGS COUNTY, SOUTH DAKOTA

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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0 1/2 1 Mile Scale 1:20 000 0 5000 Feet

28

(Sheet 20)

R. 50 W.

N

(Sheet 27)

(Sheet 29)

T. 111 N.

(Sheet 36)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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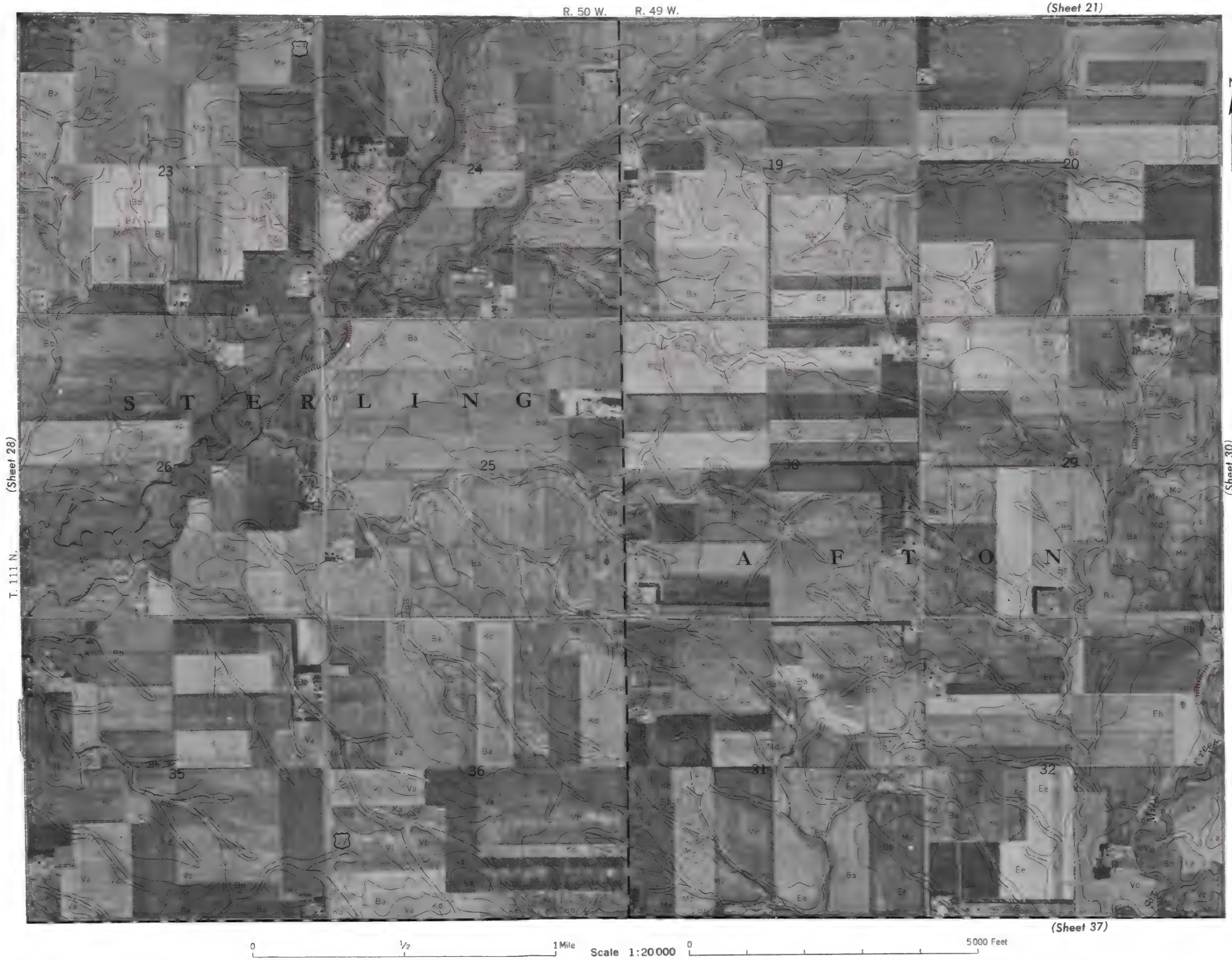
R. 50 W.
R. 49 W.
(Sheet 21)
(Sheet 28)
T. 111 N.
(Sheet 30)
(Sheet 37)
N
23
24
19
20
S T E R L I N G
26
25
30
29
A F T O N
35
36
31
32
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet

30

0 1/2 1 Mile Scale 1:20000 0 5000 Feet

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R. 48 W.
(Sheet 23)
N
(Sheet 30)
T. 111 N.
(Sheet 32)
(Sheet 39)
19
20
21
22
23
30
29
28
27
26
31
32
33
34
35
S H E R M A N
Creek
Deer
0 1/2 1 Mile
Scale 1:20 000
0 5000 Feet

32

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

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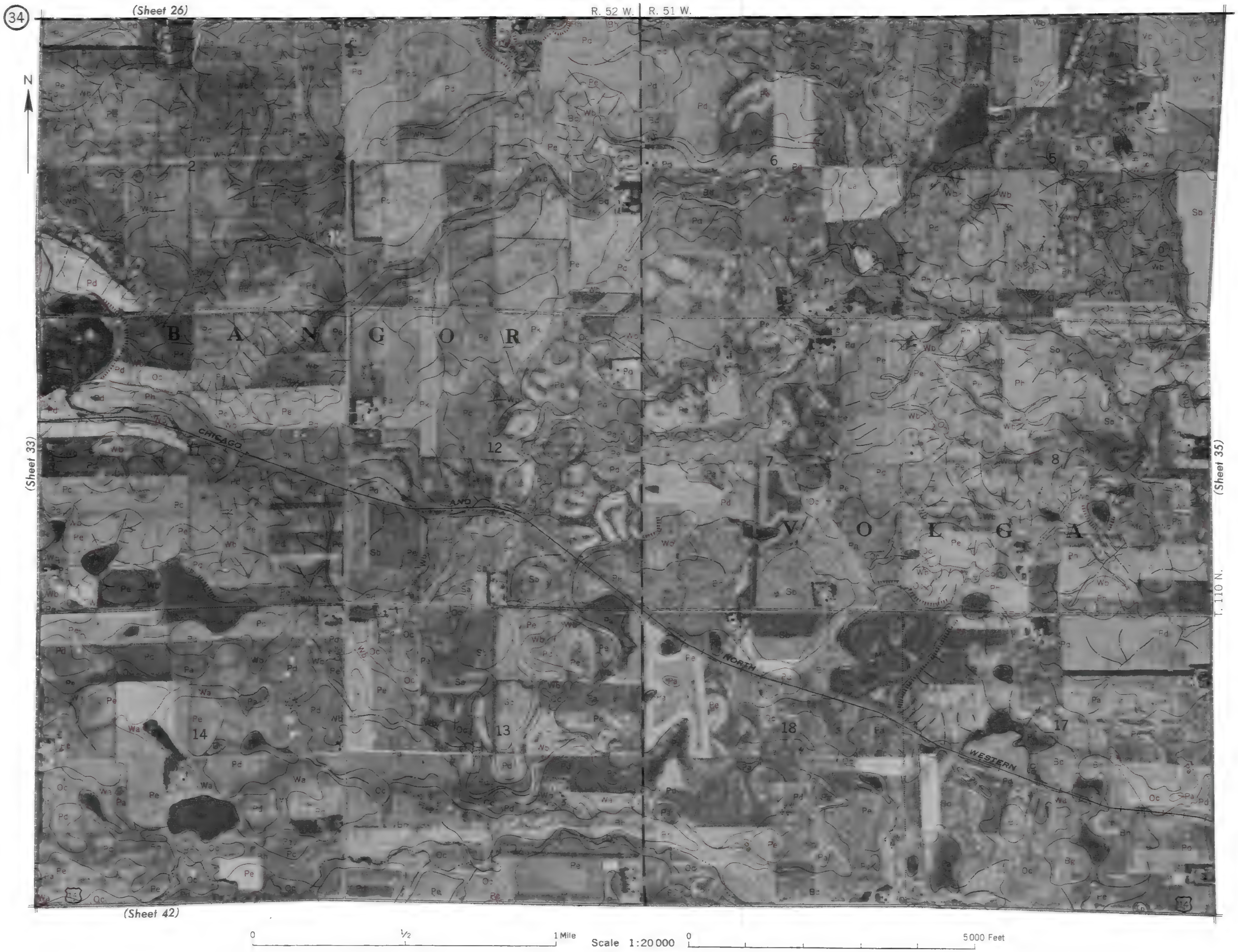
BROOKINGS COUNTY, SOUTH DAKOTA



This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1951.

R. 51 W.


(Sheet 27)
(Sheet 34)
(Sheet 36)
(Sheet 43)
T. 110 N.
N
LAKE
GOLDSMITH
VOLGA
BROOKINGS
BIG
SIOUX
RIVER
CHICAGO AND NORTH WESTERN
Sioux
Valley
Park
14
1
2
3
4
9
10
11
12
13
14
15
16
0
1/2
1 Mile
Scale 1:20000
0
5000 Feet

36

(Sheet 28)

R. 50 W.

(Sheet 44)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

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R. 50 W.
R. 49 W.
(Sheet 29)
N
B R O O K I N G S
A U R O R A
T. 110 N.
(Sheet 36)
(Sheet 38)
(Sheet 45)
2
1
6
5
11
12
7
8
14
13
18
17
Creek
0
1/2
1 Mile
Scale 1:20000
0
5000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

(Sheet 30)

R. 49 W. R. 48 W.

(Sheet 46)

0 1/2 1 Mile Scale 1:20000 0 5000 Feet

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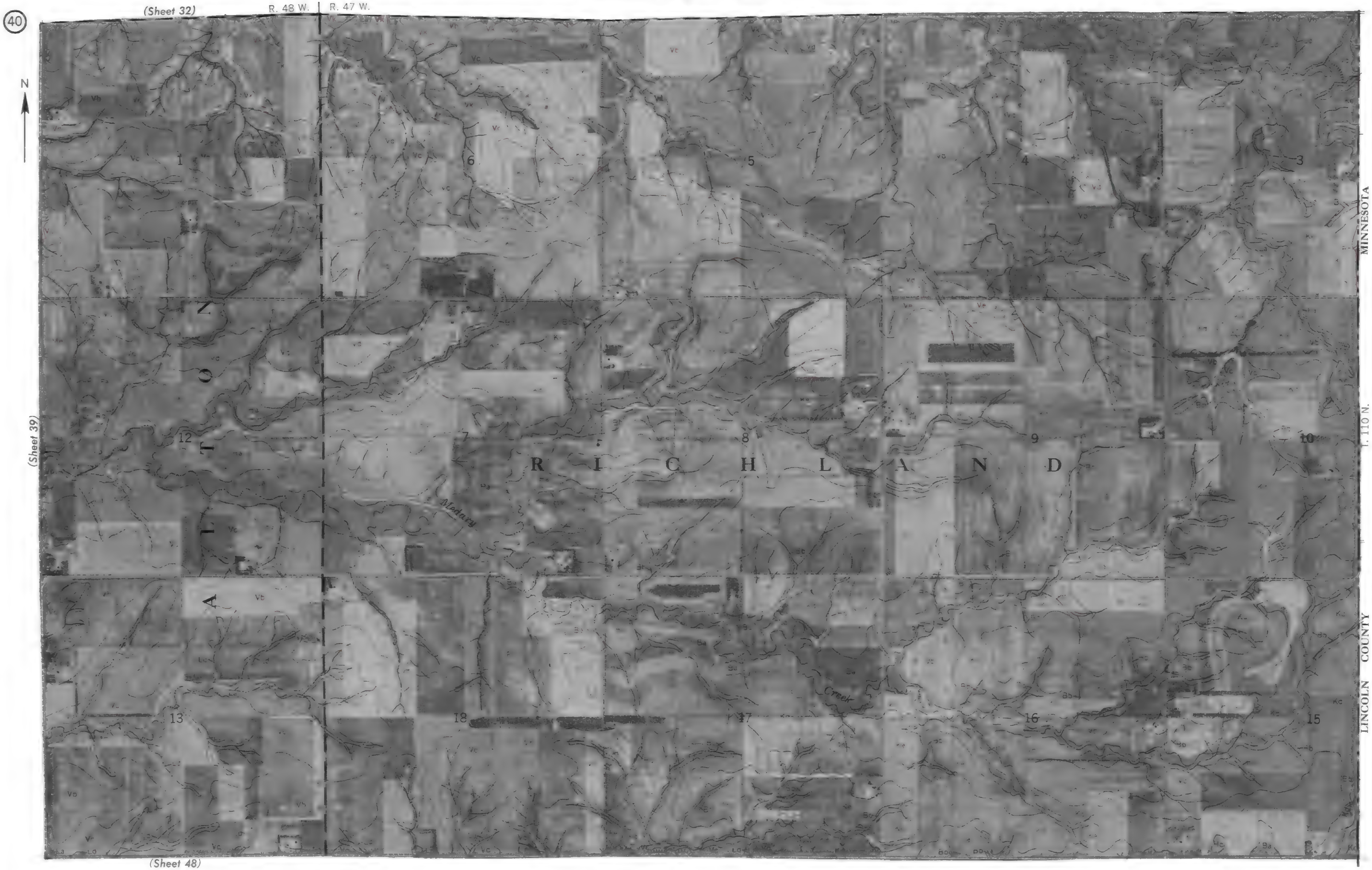
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

40



0 1/2 1 Mile Scale 1:20 000 0 5000 Feet

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R. 52 W.
(Sheet 33)
N
BRUSH LAKE
KINGSBURY COUNTY
T. 110 N.
B A N G O R
Abnberg
NORTHERN
(Sheet 42)
19
20
21
22
30
29
28
27
31
32
33
34
(Sheet 49)
0
½
1 Mile
Scale 1:20000
0
5000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

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R. 51 W.

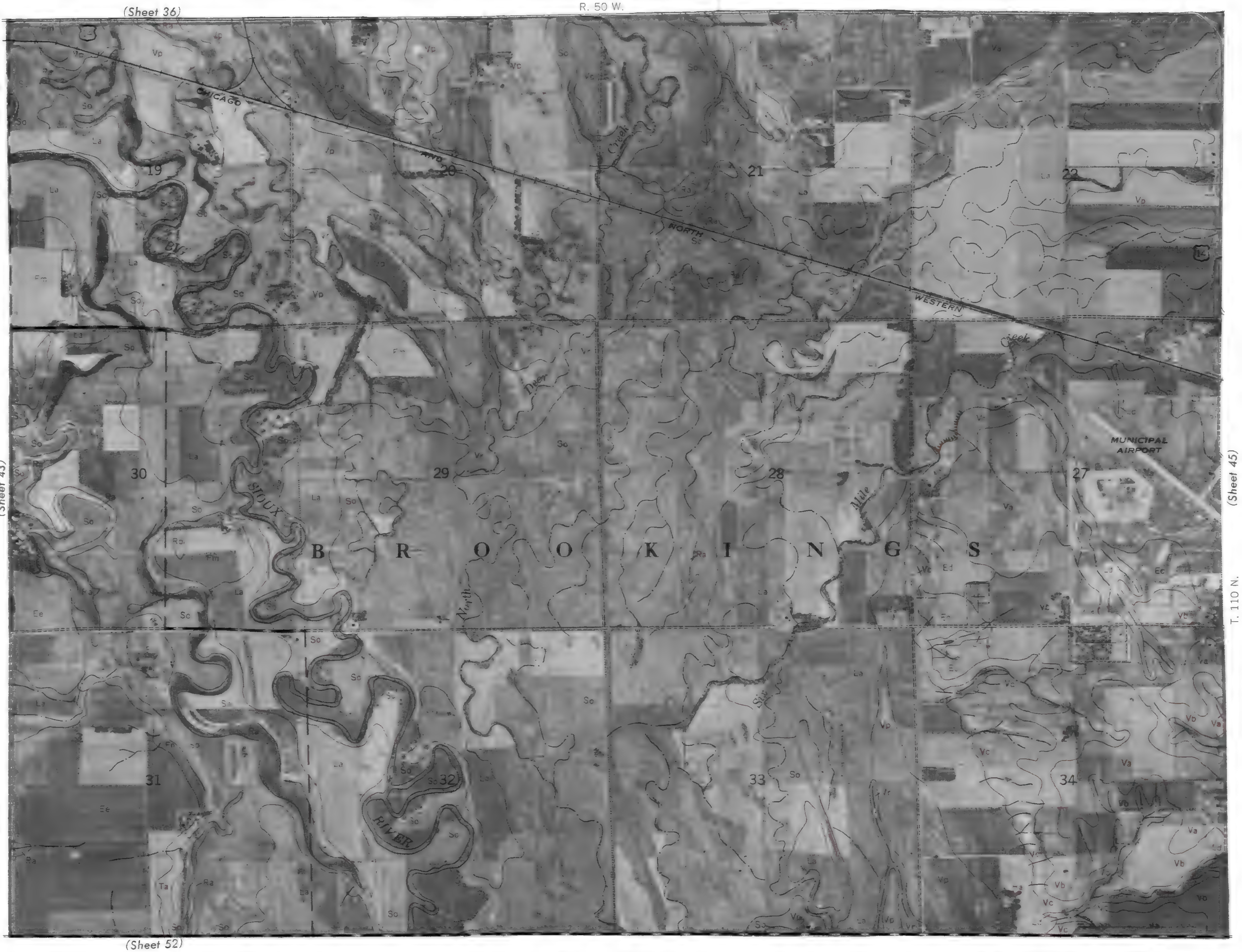
(Sheet 35)

(Sheet 51)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

44



Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

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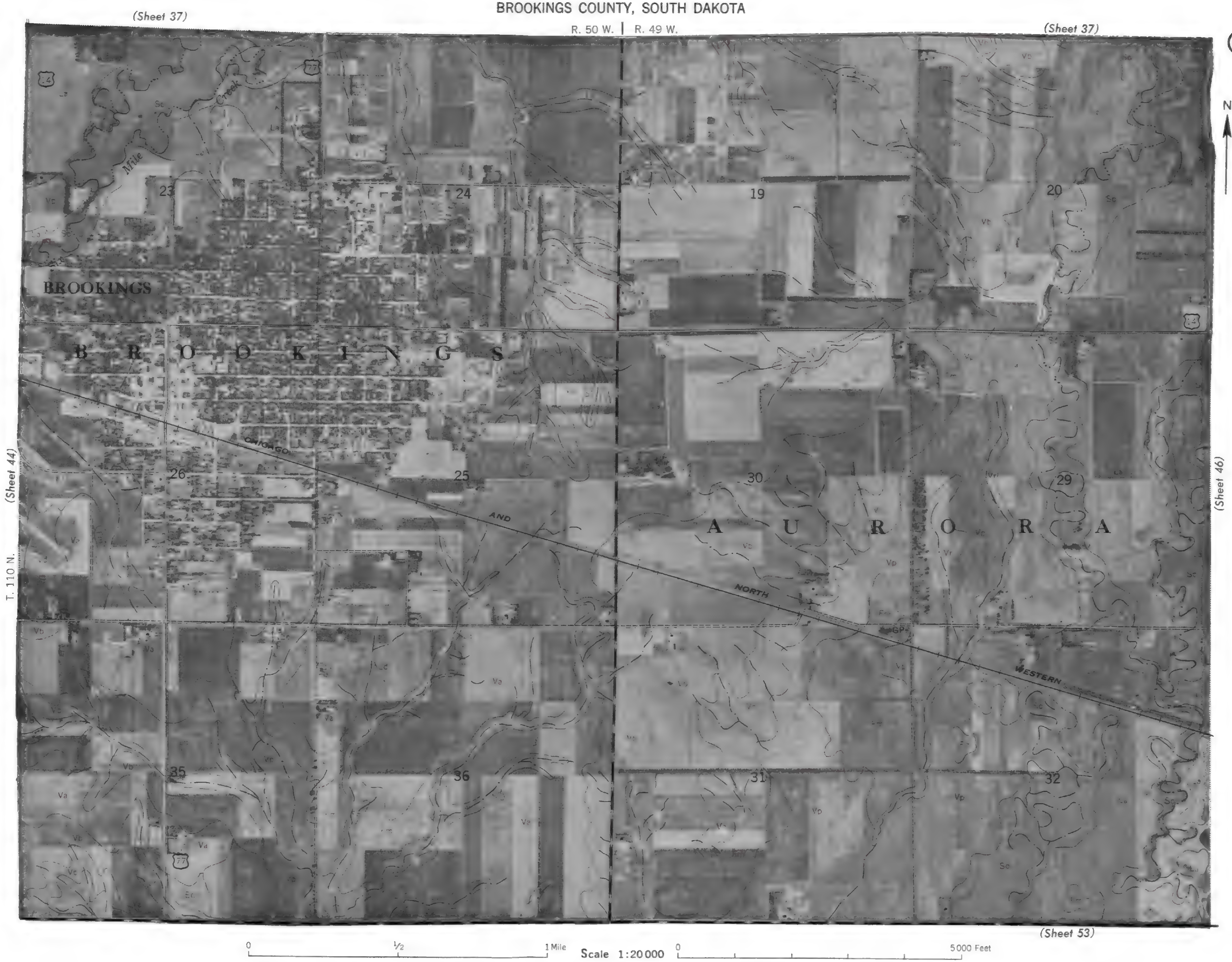
(Sheet 37)
R. 50 W. | R. 49 W.
(Sheet 37)
N
BROOKINGS
B R O O K I N G S
A U R O R A
CHICAGO AND NORTH WESTERN
(Sheet 44)
T. 110 N.
(Sheet 46)
(Sheet 53)
23
24
19
20
26
25
30
29
35
36
31
32
0 ½ 1 Mile
Scale 1:20 000
0 5000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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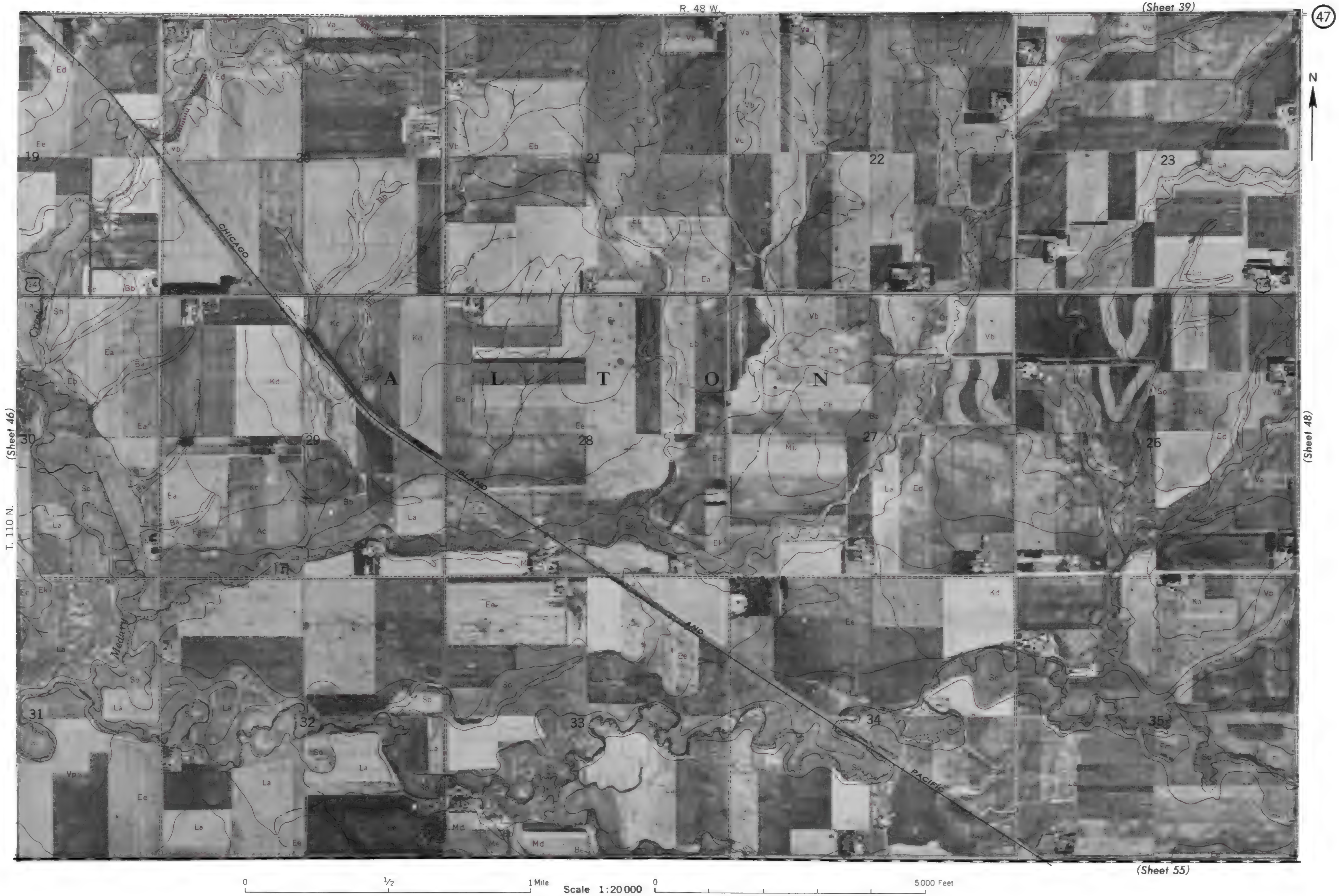
R. 48 W.
(Sheet 39)
47
N
(Sheet 46)
(Sheet 48)
T. 110 N.
(Sheet 55)
19
20
21
22
23
30
29
28
27
26
31
32
33
34
35
A L T O N
CHICAGO
ISLAND
AND
PACIFIC
Medary
Creek
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

48

This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1951


R. 52 W.
(Sheet 41)
N
GREAT NORTHERN
KINGSBURY COUNTY
T. 109 N.
(Sheet 50)
(Sheet 57)
LAKE SINAI
L A K E S I N A I
6
5
4
3
8
9
10
18
17
16
15
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

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R. 51 W.

(Sheet 43)

51

(Sheet 50)

T. 109 N.

(Sheet 52)

(Sheet 59)

0 1/2 1 Mile Scale 1:20 000 0 5000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

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R. 50 W.
R. 49 W.
(Sheet 45)
N
(Sheet 52)
(Sheet 54)
(Sheet 61)
T. 109 N.
M E D A R Y
T R E N T O N
1
2
5
6
7
8
11
12
13
14
17
18
Medary Creek
0
1/2
1 Mile
Scale 1:20 000
0
5 000 Feet

54

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

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R. 48 W.

(Sheet 47)

(Sheet 54)

T. 109 N.

(Sheet 56)

(Sheet 63)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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R. 52 W.

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

R. 52 W. R. 51 W.

58

(Sheet 50)

(Sheet 57)

(Sheet 59)

T. 109 N.

LAKE COUNTY

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

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0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

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R. 50 W.
R. 49 W.
(Sheet 53)
N
(Sheet 60)
(Sheet 62)
T. 109 N.
M E D A R Y
T R E N T O N
Medary
SIOUX
RIVER
23
24
19
20
26
25
30
29
35
36
31
32
MOODY COUNTY
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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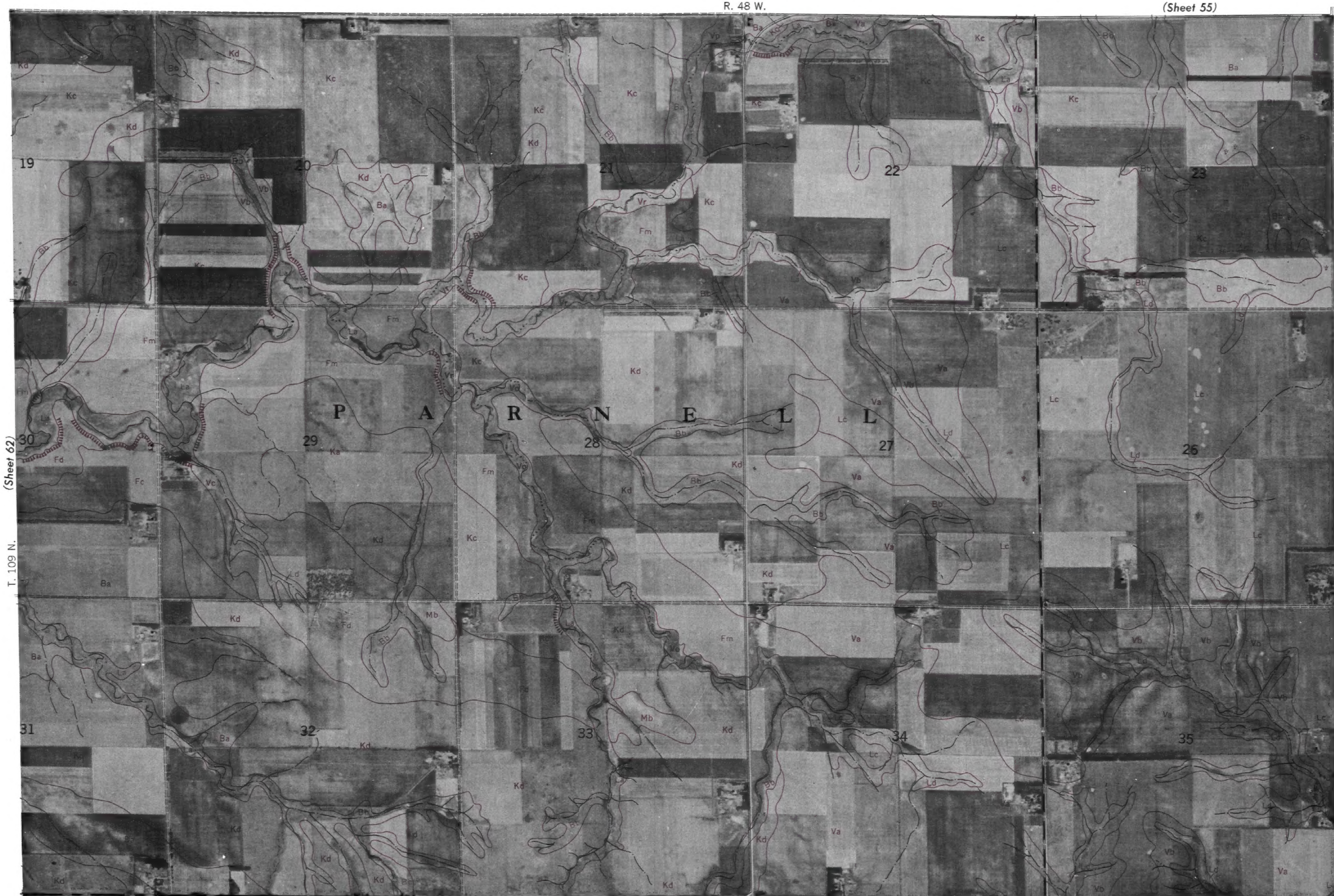
R. 48 W.

(Sheet 55)



MOODY COUNTY

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

BROOKINGS COUNTY, SOUTH DAKOTA

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